CASE NO. 14-1038

UNITED STATES COURT OF APPEALS FOR THE FEDERAL CIRCUIT

INFECTION PREVENTION TECHNOLOGIES,

Plaintiff / Counterclaim Defendant – Appellee,

v.

LUMALIER CORPORATION,

Defendant / Counterclaim Plaintiff – Appellant.

APPEAL FROM THE UNITED STATES DISTRICT COURT FOR THE EASTERN DISTRICT OF MICHIGAN IN CASE NO. 2:10-cv-12371-AC-LJM
JUDGE VICTORIA ROBERTS
(Reassigned to Judge Avern Cohn)

BRIEF OF DEFENDANT / COUNTERCLAIM PLAINTIFF – APPELLANT LUMALIER CORPORATION

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December 23, 2013

CERTIFICATE OF INTEREST

Counsel for the Appellant, Lumalier Corporation, certifies the following:

1. The full name of every party represented by me is:

   Lumalier Corporation

2. The name of the real party in interest represented by me is:

   Lumalier Corporation

3. All parent corporations and any publicly held companies that own 10 percent or more of the stock of the party or amicus curiae represented by me are:

   None

4. The names of all law firms and the partners or associates that appeared for the party now represented by me in the trial court or are expected to appear in this court are:

   Waddey & Patterson, P.C.
   John F. Triggs; Ryan D. Levy

Respectfully submitted on December 23, 2013,

/s/ John F. Triggs
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TABLE OF CONTENTS

TABLE OF AUTHORITIES

CASES

STATUTES

STATEMENT OF RELATED CASES

Appellant Lumalier Corporation (hereinafter "Lumalier") is not aware of any other appeal in or from the underlying district court action that was previously before this or any other appellate court, nor of any case pending in this or any other court that will directly affect or be directly affected by this Court's decision in the pending appeal.

LIST OF ABBREVIATIONS

IPT	Infection Prevention Technologies
UV-C	Ultraviolet-C
'424 Patent	U.S. Patent No. 6,656,424
'177 Patent	U.S. Patent No. 6,911,177
UVAS	Ultraviolet Area Sterilizer

STATEMENT OF JURISDICTION

The United States District Court for the Eastern District of Michigan had jurisdiction over the action giving rise to this appeal pursuant to 28 U.S.C. §§ 1331 and 1338(a). Declaratory judgment plaintiff Infection Prevention Technologies ("IPT") moved for summary judgment of non-infringement as to all patent claims on January 8, 2013. (A2639). Judge Victoria Roberts entered an order granting IPT's motion on May 9, 2013, leaving only plaintiff's other tort claims remaining in the lawsuit. (A43). One month later, the case was reassigned by order of the Court from Judge Roberts to honorable Judge Avern Cohn on June 10, 2013. (A3606). Although other tort claims are still pending before the district court, the Parties agreed to an interlocutory appeal to have this Court review the claim construction and the summary judgment rulings.

The Parties filed a Joint Motion for Entry of Final Judgment Pursuant to Rule 54(b) on October 9, 2013. (A4024). Two days later, Judge Cohn entered an order granting final judgment as to the patent claims. (A4038). Lumalier filed a timely Notice of Appeal on October 18, 2013 seeking review of both the district court's *Markman* ruling and the Order granting summary judgment of non-infringement. (A4040). Pursuant to 28 U.S.C. § 1295(a)(1), this Court has jurisdiction over this appeal based on entry of the final judgment with respect to the patent-related claims and counterclaims.

STATEMENT OF THE ISSUES ON APPEAL

1. Whether the district court erred in construing the claim term "reflected ultraviolet-C radiation" and its variations to include the exclusionary negative limitation "as opposed to radiation that is from the UV-C device directly."

2. Whether the district court erred in construing the claim term "measuring" and its variations based on an extrinsic dictionary definition that is neither consistent with the plain and ordinary meaning nor supported by the specification.

3. Whether the district court erred in granting summary judgment that the accused products do not literally infringe the asserted claims of the '424 and '177 Patents.

4. Whether the district court erred in granting summary judgment that prosecution history estoppel prevents the accused products from infringing the asserted claims of the '424 and '177 Patents under the doctrine of equivalents.

STATEMENT OF THE CASE

On June 15, 2010, Infection Prevention Technologies, LLC ("IPT") filed a Complaint against Lumalier Corporation ("Lumalier") seeking a declaratory judgment that IPT's ultraviolet sterilization devices do not infringe any claims of U.S. Patent Nos. 6,656,424 ("the '424 Patent"); 6,911,177 ("the '177 Patent"); and 7,175,806 ("the '806 Patent). (A90). IPT's Complaint also asserted several business and other tort causes of action against Lumalier. (A100-102). IPT's claims relating to the '806 Patent were dismissed by order of the district court due to lack of jurisdiction on September 19, 2011. (A706).

Lumalier filed an Answer on October 3, 2011, and an amended Answer on October 21, 2011 with counterclaims asserting infringement of the '424 and '177 Patents against the IPT devices. (A719; A816).

The dispute in this case has centered on construction of two claim terms, "reflected ultraviolet-C radiation" and "measuring" found in the asserted claims of both the '424 and '177 Patents. The Parties submitted opening claim construction briefs on May 23, 2012 offering different proposed constructions of these claim terms, as well as differing constructions for other disputed terms. (A1924; A2083). An oral claim construction hearing was held on July 24, 2012 before Judge Roberts. Two weeks later, on August 8, 2012, the district court issued a claim construction order. (A1).

On January 8, 2013, IPT filed a second Motion for Summary Judgment of Non-infringement.[1] (A2639). Relying on an erroneous claim construction, the district court entered an order on May 9, 2013 granting IPT's Motion for Summary Judgment of Non-Infringement. (A43).

STATEMENT OF FACTS

Lumalier Corporation is a leader in the field of ultraviolet disinfection devices. Lumalier's products are used in many hospitals and medical research facilities around the world. In 2009, Lumalier acquired an exclusive license to the '424 and '177 Patents (collectively "the Patents") seeking to further expand its product line. (A436). Lumalier subsequently began marketing and selling a portable ultraviolet disinfection device called the "TRU-D". Since its inception, Lumalier's TRU-D device has received widespread acceptance as a superior, industry leader in the field of portable ultraviolet disinfection devices for use in medical facilities. Multiple third-party studies have been conducted and published relating to the effectiveness of the TRU-D device for disinfecting surfaces. (A4170). Lumalier's impact on the staggering human and financial cost of disinfecting hospitals has already been a game-changing breakthrough.

[1] IPT'S first motion for summary judgment of non-infringement was denied as premature. (A1921).

A. The Patents

The ’424 and ’177 Patents are both titled “Ultraviolet Area Sterilizer and Method of Area Sterilization Using Ultraviolet Radiation.” (A57; A65). The ’177 Patent is a continuation-in-part of the ’424 Patent. (A69).

The Patents are directed to devices and methods for disinfecting rooms and similar spaces using ultraviolet radiation. A common application for this technology is for disinfecting public spaces such as hospital and operating rooms, as many pathogens can be transmitted via surfaces and air. (A4170). The Patents recognize the ability of ultraviolet radiation in the UV-C band to penetrate and disrupt the DNA of many common pathogens, rendering them harmless and unable to reproduce. (A4171). The Patents provide a great improvement over conventional methods for hospital cleaning, which rely on chemical disinfection requiring workers to manually wipe down all exposed surfaces.

The inventions of the Patents also introduced, *inter alia*, radiation-sensing technology for use in combination with UV-C emitters to monitor the administered dose of UV-C radiation to ensure adequate disinfection. (A62). By using light sensors oriented to face outwardly into a room to measure reflected UV-C radiation, the inventions of the Patents made it possible to operate more efficiently by terminating emission after an adequate dose has been verified. Prior to the

inventions taught and claimed by the Patents, the art did not teach how to monitor the dose of UV-C radiation reflected in an environment to ensure an adequate amount was present to effectively disinfect an area.

In an exemplary embodiment of the claimed invention, a mobile or stationary ultraviolet area sterilizer ("UVAS") is placed in a room where concern exists regarding the presence of pathogens on environmental surfaces. In the words of the "Summary of the Invention":

> After the bulbs have reached a steady state of output, an array of UV-C sensors scan the room, and determine the darkest area, or the area reflecting the lowest level of UV-C back to the sensors. A BASIC Stamp contained in the device calculates the time required to obtain a bactericidal dose of UV-C reflected back from darkest area. The UVAS transmits the calculated dose of UV-C, as well as other monitoring information, to the remote control where it is displayed to the operator. Once a bactericidal dose has been reflected to all the sensors, the unit notifies the operator and shuts down. By relying on reflected doses rather than direct exposure, the UVAS is able to sterilize or sanitize all surfaces within the room that are within view of an exposed wall or ceiling. The pathogenic bacteria in the room have been effectively eliminated.

(A61, col. 2, ll. 27-42.) Briefly stated, reflected doses of UV-C radiation are relied on to disinfect surfaces that are not in direct line of sight of the UVAS unit. (A62, col. 4, ll. 50-67). The invention of the Patents determines that a bactericidal dose has been delivered based on reflected radiation as measured by the unit. (A62, col. 3, ll. 29-44). Therefore, a critical distinction between the invention and previously known methods of delivering UV-C radiation is the ability to detect and utilize

information associated with radiation that is reflected back to the device from the surroundings.

B. Infection Prevention Technologies and the Accused Product

IPT was formed in 2009 when a former Lumalier employee, Mark Statham – while still working for Lumalier – used one of Lumalier's TRU-D devices to design the IPT device. (A2277-A2278; A2291, ll. 14-20). Using the TRU-D device as a template, and without Lumalier's knowledge or authorization, Mr. Statham and his team developed a product known as the IRS3200 intended to compete with Lumalier's TRU-D device. (A4348-A4349).

In 2009, IPT contacted the owner of the '424 and '177 Patents seeking a license; but no deal was reached, and IPT was never granted a license to practice this technology. (A159-160; A3007-A3008). Despite not being granted a license, IPT began manufacturing and selling its competing IRS3200 product at least as early as 2011. (A2467). IPT marketed its competing product as a direct competitor and an improvement of the TRU-D. Much of IPT's marketing material compared the IRS3200 to the TRU-D, and IPT openly marketed its product as being able to determine room characteristics and set treatment time based on its ability to detect reflected ultraviolet-C radiation.

C. Prosecution History of the '424 Patent

On April 8, 2003, an Office Action was mailed by the U.S. Patent and Trademark Office ("PTO"), rejecting pending claims 3-4 of the '424 Patent as anticipated under 35 U.S.C. § 102 by U.S. Patent No. 5,891,399 ("Owesen"), and further rejecting claims 1-2 as being unpatentable under 35 U.S.C. § 103 over Owesen in view of German publication DE 29812427 ("the German reference") and U.S. Patent No. 6,433,343 ("Cimino"). (A993).

The attorney for the Applicant, Mr. Bill Killough, responded to the Office Action by distinguishing each of the cited prior art references as teaching sensors positioned remote from the emitters facing back toward the emitters such that the sensors could only detect direct radiation. Mr. Killough further explained operational control of the claimed invention is provided by detecting and utilizing data associated with reflected radiation. (A1008). For example, sensors as disclosed in Cimino and the German reference were characterized as being able to receive and measure only direct radiation from their respective emitters. (A1009-A1010).

Mr. Killough also argued the Owesen reference failed to teach detection of any direct or reflected radiation, and further that a UV probe (i.e., sensor) as disclosed in Owesen would be unable to measure reflected radiation. (A1010-A1012). Furthermore, Mr. Killough also stated that Owesen fails to identify any

particular location for the UV probe. (A1012). Noting this ambiguity in Owesen, Applicant stated "[e]ven if there is incidental reflected radiation that is received by the probe (which is not indicated by Owesen), **there is no indication in the reference that the reflected radiation is measured**." (A1012) (emphasis added).

Applicant also noted that Owesen is directed to an air sterilizer that forces air particles through a central passage inside the device, resulting in a dynamic, changing environment. On this point, Applicant stated, "a mixture of reflected and direct measurement by an individual sensor negates the ability to determine adequate exposure and decontamination **in a changing environment**." (A1012) (emphasis added). In making this comment, Applicant distinguished the dynamic, changing environment of the target surfaces in Owesen (forced stream of moving air particles) from the static target surfaces of the present invention (stationary surfaces in a room). (A1012).

Finally, Applicant distinguished Owesen on the basis that any UV probe feedback in Owesen was explicitly taught for use other than lamp control, stating:

> The probe of Owesen is not shown in his drawings, or clearly explained, however, the probe, to the degree that it is explained, measures output power from the tubes, so that the **control means can govern the rotational speed of the fan**.

(A1011; *see also* A1109, col. 6, ll. 34) (emphasis added).

The '424 Patent was subsequently issued on December 2, 2003, without further action by the PTO on the merits of the claims. (A57).

SUMMARY OF THE ARGUMENT

A. Claim Construction

The district court first erred in its construction of the terms "reflected ultraviolet-C radiation" and "measuring" as those terms appear in the '424 and '177 Patents. (A1). In construing the claim term "reflected ultraviolet-C radiation," the district court improperly imported limitations from the specification and erroneously applied the doctrine of prosecution disclaimer where no clear and unambiguous disavowal occurred. (A21). In construing the claim term "measuring," the district court ignored the specification and instead relied on an extrinsic dictionary – Webster's New College Dictionary II – definition that is inconsistent with the plain and ordinary meaning as understood by those of skill in the art. (A22, A25).

B. Summary Judgment of Non-infringement

The district court further erred in granting summary judgment of both no literal infringement and no infringement under the doctrine of equivalents. The district court ignored substantial evidence, including Lumalier's undisputed expert analysis concluding the accused products meet the limitations of the asserted claims, both literally and as equivalents. (A43).

Specifically, the evidence demonstrates the accused products operate with as many as five lamps disabled due to limited power availability in the IPT products

during normal operating conditions, and as many as eight lamps disabled during periods of low battery power. (A3017). Consequently, the evidence shows at least one radiation sensor assembly in the accused IPT products literally receive only reflected radiation when the emitters below the sensor are disabled. IPT strenuously disputes this material fact. However, a reasonable jury could conclude that the accused products literally meet the limitations of the asserted claims, even under the district court's flawed claim construction, because the evidence shows the accused IPT products always operate with multiple emitters turned off – allowing at least one sensor to receive only reflected UV-C radiation.

Additionally, the evidence of literal infringement includes the presence of a Teflon cap that completely covers the photodiode sensor in the accused IPT products. (A2747-A2749). Lumalier's expert, Dr. Richard Alan Peters, concluded the Teflon cap blocks all direct radiation from the emitters. (A2752, para. 128, 131). Thus, even applying the district court's erroneous claim construction, a reasonable jury could also conclude the accused IPT products literally meet the limitations of the asserted claims due to the presence of the Teflon cap blocking all radiation that is from the emitters directly.

Finally, Lumalier's expert Dr. Peters opined that the differences between the accused IPT products and the inventions of the asserted Claims are insubstantial. The accused products perform substantially the same function as the claimed

inventions in substantially the same way to achieve substantially the same result. (A2776, para. 212; A2787; A2802; A3000, ll. 10-12). To refute this fact, IPT did not provide any contradictory expert analysis, but instead relied only on attorney argument and the unqualified layperson testimony of its co-founder Mark Statham.

The district court further erroneously applied argument-based prosecution history estoppel and failed to consider the entirety of the prosecution record, including the teachings of the prior art. And the district court's prosecution history estoppel analysis also took Applicant's statements out of context. The arguments made by the Applicant during prosecution of the '424 Patent were not a clear and unmistakable surrender of IPT's attempted design-around. Instead, any surrender generated by Applicant's arguments is limited only to the embodiments disclosed by the prior art references. Such surrender does not extend as broadly as held by the district court so as to exclude IPT's accused products from infringement.

Additionally, there can be no disclaimer or prosecution history estoppel in this case because Applicant's statements made during the prosecution of the '424 Patent in Applicant's May 14, 2003 Office action Response were directed to newly added Claims 5-20 which each recited "only reflected radiation." Those comments were not directed to the broader original Claims 1-4 that did not, and do not as issued, include the "only" language. Because these arguments are open to multiple reasonable interpretations, there can be no clear and unmistakable surrender.

ARGUMENT

The district court erred in granting summary judgment of non-infringement by the accused devices of IPT. The district court's error was, in part, a result of previous errors in interpreting the claim terms "measuring" and "reflected ultraviolet-C radiation." Thus, Lumalier will first address why the district court's interpretations of at least these two terms, and various combinations of these terms, were erroneous.

I. THE DISTRICT COURT ERRED IN ITS CLAIM CONSTRUCTION.

This Court reviews a district court's claim construction *de novo*. *Cybor Corp. v. FAS Tech., Inc.*, 138 F.3d 1448, 1454-56 (Fed. Cir. 1998) (*en banc*). This Court reviews the grant or denial of summary judgment under the laws of the regional circuit. *MicroStrategy, Inc. v. Bus. Objects, S.A.*, 429 F.3d 1344, 1349 (Fed. Cir. 2005). The Sixth Circuit reviews grants of summary judgment *de novo*, asking whether any "genuine issue of material fact exists" and drawing "all reasonable inferences in the light most favorable to the nonmoving party." *Vaughn v. Lawrenceburg Power Sys.*, 269 F.3d 703, 710 (6th Cir. 2001).

Whether prosecution disclaimer applies is a legal question that this Court also reviews *de novo*. *Cybor Corp.*, 138 F.3d at 1456. Prosecution disclaimer may only be found where the alleged disavowing actions or statements made during prosecution are both clear and unmistakable. *Omega Eng'g, Inc. v. Raytek Corp.*,

334 F.3d 1314, 1325-26 (Fed. Cir. 2003) ("We have required the alleged disavowing statements to be both so clear as to show reasonable clarity and deliberateness . . . and so unmistakable as to be unambiguous evidence of disclaimer."). Additionally, "[w]here an applicant's statements are amenable to multiple reasonable interpretations, they cannot be deemed clear and unmistakable." *3M Innovative Props. Co. v. Tredegar Corp.*, 725 F.3d 1315, 1326 (Fed. Cir. 2013).

A. The District Court Erred in Interpreting the Claim Term "Reflected Ultraviolet-C Radiation" to Include Negative Limitations.

The district court interpreted the claim term "reflected ultraviolet-C radiation" to mean "radiation that is reflected from items in an area as opposed to radiation that is from the UV-C device directly." (A21). On its face, this construction would appear to be merely distinguishing radiation that is reflected from radiation that is not reflected – i.e., that which is received directly from the UV-C emitters and is not reflected off of an intervening surface. However, the district court's analysis of this term repeatedly and improperly cited the specification and prosecution history for the '424 Patent as disavowing claim scope. The district court concluded the Applicant disclaimed embodiments wherein both reflected and direct radiation may be received by a sensor. (A20,

ll. 18-20). This error led directly to the imposition of negative limitations in construing this claim term and all associated variations.

There is no dispute regarding the importance of reflected UV-C radiation within the scope of the invention. IPT must use data associated with reflected UV-C radiation to do what the '424 and '177 Patents teach. Operational control by utilizing data representative of reflected radiation is important, at least in part because reflected radiation is relied on to disinfect shadowed surfaces that are out of the line of sight of the UVAS unit. (A61, col. 2, ll. 35-42). Therefore, one aspect of the invention is that the sensors must be oriented facing outwardly away from the device to be capable of detecting radiation that is reflected back to the device from the surroundings.

There is no dispute about whether or not the term "reflected" radiation encompasses "direct" radiation. The intrinsic evidence consistently distinguishes UV-C radiation that is reflected off items in a room from radiation that is directly received from a UV-C emitter, i.e., radiation that does not bounce off of any intervening surface. Such a distinction is clearly in accordance with an ordinary meaning of the respective terms.

However, the district court incorrectly construed the term "reflected UV-C radiation" such that "receiving" or "measuring" reflected UV-C radiation in the context of the patent claims further was construed to require "receiving" or

"measuring" reflected UV-C radiation as opposed to direct UV-C radiation. One preferred mode of the invention may involve positioning the sensors to allow no direct UV-C radiation, and this is indeed an embodiment described throughout the specification. And this is indeed an embodiment described throughout the specification, in Claims 6-20 of the '424 Patent. However, additional modes might include, for example, a unit arranged to receive an inconsequential amount of direct UV-C radiation, or a known and invariable "baseline" level of direct UV-C radiation. Either of these two cases would allow the unit to measure reflected radiation, either by ignoring or compensating for the direct radiation, respectively. This Court has "expressly rejected the contention that if a patent describes only a single embodiment, the claims of the patent must be construed as being limited to that embodiment." *Phillips v. AWH Corp.*, 415 F.3d 1303, 1323 (Fed. Cir. 2005) (*en banc*). While it is clear from the intrinsic evidence that reflected UV-C radiation must be received and measured, there is nothing in the specification or the prosecution history which clearly and unmistakably warrants an interpretation that direct UV-C radiation must not be received and measured.

The district court repeatedly took the intrinsic evidence out of context in order to support its improper construction. In one example of the district court's analysis, it asserts that because the specification reads "[the sensors] are oriented away from the UVAS, thus measuring the dose of UV-C reflected back to the

unit," the sensors are therefore only capable of measuring reflected radiation as opposed to direct radiation. (A15). However, this passage merely discloses that the UVAS is capable of measuring reflected UV-C due to the orientation of the sensors, but does not preclude the sensors from receiving any direct radiation.

The district court on numerous occasions misrepresents another passage in the specification as requiring only reflected radiation: "By relying on reflected doses rather than direct exposure, the UVAS [later TRU-D] is able to sterilize or sanitize all surfaces within the rooms that are within view of an exposed wall or ceiling." (A55). As noted previously, however, this citation within the context of the specification as a whole simply refers to the ability of the UVAS to sterilize even those surfaces that are not directly exposed to direct UV-C radiation from the device. While it is clear that reflected UV-C radiation is relied upon to fully sterilize a room where such surfaces exist, and that the device is accordingly programmed to provide a bactericidal dose in view of a determined cumulative level of reflected UV-C radiation, the specification does not support the district court's restrictive interpretation.

The prosecution history also fails to support the interpretation of the district court. As previously noted, each of the cited prior art references were distinguished on the grounds that they could not measure reflected radiation at all. Cimino and the German reference plainly could not receive any reflected radiation.

(A1009-A1010). Owesen was distinguished by the Applicant in that even if there were some incidental reflected radiation to be received by the disclosed probe: "A mixture of reflected and direct measurement by an individual sensor negates the ability to determine adequate exposure and decontamination in a changing environment." (A1011-A1012).

Owesen is directed to an air sterilizer that forces air particles through a duct using a fan. Applicant's statement regarding a changing environment distinguished Owesen in that the sterilization target in Owesen is constantly moving and changing position as the air particles move through the duct. The district court completely ignored the "changing environment" phrase in Applicant's argument. However, an alternative, reasonable interpretation of Applicant's statement is that Applicant was merely distinguishing the dynamic, changing environment of the target surfaces in Owesen (forced stream of moving air particles) from the static target surfaces of the present invention (stationary walls and surfaces in a room). (A1012). Because Applicant's statement is open to multiple reasonable interpretations, there can be no "clear and unmistakable" surrender of claim scope. *See, e.g., Northern Telecom Ltd. v. Samsung Elecs. Co.*, 215 F.3d 1281, 1293-97 (Fed. Cir. 2000) (no prosecution disclaimer where statements in prosecution history were open to multiple reasonable interpretations and were thus ambiguous).

The district court further determined that reflected radiation must be radiation that is reflected from the walls and ceiling of a room, rather than from the UVAS device itself, citing to the prosecution history for support. (A17-A18). However, the cited passage merely recites a single example, wherein: "The device directs UV-C radiation within, for example, a room, and at the walls and ceilings of a room." (A1006). Such a narrow reading is further at odds with the specification itself, which clearly provides for radiation reflected from the device:

> Trials of the UVAS in actual operating rooms and endoscopy suites and exam rooms as well as simulated trials have been performed . . . . ***Subsequent trials of a unit modified to increase reflectance off the unit itself*** sterilized the surfaces of the same bacterial species within one minute.

(A62, col. 4, ll. 43-53) (emphasis added). Therefore, a more appropriate interpretation of reflected radiation would encompass not only radiation that is reflected from items in an enclosed area such as the walls and ceiling of a room, but also radiation that is reflected from the device.

To fully comprehend the effect of the negative limitations within the district court's construction, it is important to consider the claims in context. For example, in Claim 1 of the '424 Patent, the claim term "measuring a reflection of ultraviolet-C radiation from each of multiple points within said enclosed area" thus requires measuring radiation that is reflected from items in an area as opposed to radiation from the UV-C device directly. The district court held that only reflected radiation

was measured. This conclusion is not supported by the written description or by the prosecution history, which merely provides that some reflected radiation is sensed and utilized for operational control.

The district court further erred in failing to properly consider the doctrine of claim differentiation. The law in this Court has established that a comparison between different independent claims for claim differentiation purposes may be useful to determine the meaning of disputed terms. *Hologix, Inc. v. Senorx, Inc.*, 639 F.3d 1329, 1336 (Fed. Cir. 2011). Further, when applied to two independent claims, "claim differentiation takes on relevance in the context of a claim construction that would render additional, or different, language in another independent claim superfluous . . . ." *Curtiss-Wright Flow Control Corp. v. Velan, Inc.*, 438 F.3d 1374, 1381 (Fed. Cir. 2006). While independent Claims 6 and 14 include the word "only" in front of the term "reflected ultraviolet-C radiation," independent Claims 1 and 3 of the '424 Patent and independent Claim 1 of the '177 Patent explicitly lack this limitation. The district court's construction effectively inserts the word "only" into every claim, thereby rendering that word superfluous and meaningless in the claims where it is already present.

For at least the above reasons, the term "reflected ultraviolet-C radiation" should therefore be construed to mean "any ultraviolet-C radiation that bounces off any surface." Alternatively, the term should be interpreted to mean "radiation that

is reflected from items in an area" alone, without the negative limitations improperly applied by the district court. In correcting the foregoing error, the new construction should be applied in kind to each of the disputed claim terms in which "reflected ultraviolet-C radiation" and its variations are present.

B. The District Court Erred in Interpreting the Claim Term "Measuring" in View of Extrinsic Dictionary Definitions Rather than the Written Description.

The district court construed the term "measuring" to mean "determining the quantity of [something]." (A25). The district court based this construction on extrinsic dictionary definitions. (A22). However, this construction is erroneous because it clearly ignores the ordinary meaning of the term as provided in the specification and as understood by those of skill in the art with respect to UV sensors.

A simple perusal of the written description of the Patents provides that a level of UV-C radiation is "measured" by the array of sensors, while outputs from the sensors are "measured" by a series of programmable microcontrollers known as BASIC Stamps:

> The BASIC Stamps continuously receive a voltage input from sensors which receive reflected UV-C radiation. The sensors continuously sense the level of UV-C radiation which is reflected back to the device from 360° around the device. Eight sensors may be used. Each sensor converts the measurement of the level of radiation to a voltage output, which is transmitted to the BASIC Stamp. The BASIC Stamp samples the voltage received at intervals and adds the cumulative total of the voltage received. When the BASIC Stamp determines that the

> reflected UV-C radiation received by each and every sensor has reached the predetermined minimum cumulative total, the BASIC Stamp causes the device to shut down, and a signal is given to the operator that the process has been completed. The BASIC Stamp is programmable to measure voltage inputs as required by the particular application.

(A62, col. 3, ll. 29-44). This passage indicates that a voltage output provided by individual sensors is ***representative of*** a quantity of UV-C radiation received by the respective sensor, but nowhere is it suggested that a specific quantity of radiation is determined by the sensors.

Rather, the exact opposite is the case – the BASIC Stamp merely adds a cumulative total of the voltage received and accordingly is able to determine "that the reflected UV-C radiation received by each and every sensor has reached the predetermined minimum cumulative total." *Id*. In other words, a quantity of reflected UV-C radiation is itself never actually determined; rather a proxy for the quantity (i.e., using the generated output voltage) is used based on the programming of the BASIC Stamp to determine when a predetermined value has been reached. The written description includes nothing that would limit the programming of the BASIC Stamp. It might for example treat all of the input voltage as representing a quantity of reflected radiation – such as where there is no direct radiation or a known and statistically insignificant amount of direct radiation. It might further compensate for a known amount of direct radiation by simply subtracting a nominal voltage from the amount provided by the sensors,

applying the remainder as being representative of a quantity of reflected radiation. None of these exemplary possibilities are precluded by the intrinsic evidence, as each permits operational control based on reflected UV-C radiation.

The construction proposed by IPT, and as adopted by the district court, fails to read upon any disclosed embodiment of the invention. The written description better supports an interpretation of "measuring" as originally proposed by Lumalier – namely, "generating data associated with," or alternatively, "generating data associated with a quantity of [something]." (A2097-98).

In correcting the foregoing error, the new construction should be applied in kind to each of the disputed claim terms in which "measuring" and its variations is included.

II. THE DISTRICT COURT ERRED IN GRANTING SUMMARY JUDGMENT OF NON-INFRINGEMENT.

Relying on its erroneous claim construction, the district court granted summary judgment that the accused IPT products do not infringe the asserted claims of the '424 or '177 Patent, either literally or under the doctrine of equivalents. However, even applying the flawed claim constructions relied on by the district court, summary judgment of non-infringement is still not appropriate because material facts remain in dispute regarding both the literal operation and

structure of the accused products and the test for equivalence under the function-way-result test.

A. The District Court Erred in Granting Summary Judgment of No Literal Infringement.

In granting summary judgment of no literal infringement, the district court concluded the accused products do not literally infringe because the sensors in the accused products allegedly receive a mixture of both reflected UV-C radiation and UV-C radiation from the emitters directly. (A49).

Lumalier asserted Claims 1-9 of the ’424 Patent and Claims 1-3 of the ’177 Patent. Independent Claims 1 and 6 of the ’424 Patent are method claims, and independent Claims 3 and 14 of the ’424 Patent are apparatus claims. Additionally, Claims 1 and 3 of the ’424 Patent are not expressly limited to “only reflected radiation,” whereas Claims 6 and 14 of the ’424 Patent expressly recite “only reflected radiation” in the claim language. The district court’s summary judgment Order fails to identify on a claim-by-claim basis which claim limitations are allegedly missing in the accused products.

1. The Accused Products Always Operate with Multiple UV-C Emitters Disabled.

The accused IPT products include sixteen UV-C emitters and eight UV-C sensor assemblies. (A2743, para. 73, 76; A3011, ll. 3-4). A UV-C sensor assembly is positioned directly above every other UV-C emitter around the

perimeter of the accused device. *Id.* In an effort to avoid infringement, each IPT sensor assembly has a slight downward tilt of approximately five degrees such that a portion of light from the emitter below it travels upwardly and is incident on the exterior of the sensor assembly. (A2750, para. 121).

IPT's own witnesses confirmed that conventional electrical outlets do not provide enough electrical current to simultaneously power all sixteen emitters. (A3017). To overcome this problem, the IPT products include an internal battery system to provide additional power to four of the sixteen lamps. Those four lamps are referred to as "battery-powered lamps" and the remaining twelve lamps are referred to as "AC-powered" lamps. (A3012, ll. 9). Of the four lamps designated as "battery powered," the record clearly shows the batteries are not strong enough to power all four – so **at least one of the "battery powered" lamps is always disabled during normal use**. (A3013, ll. 7-10).

The remaining twelve "AC-powered" lamps in the accused IPT products also require more current than is available from standard 120-volt electrical outlets. (A3012). Conventional electrical outlets generally operate in either 20-amp or 15-amp circuits. The record shows that, when using a conventional 20-amp electrical circuit, the accused product can only power eleven of the twelve AC-powered lamps, meaning **at least two of sixteen lamps are always disabled during normal use with 20-amp circuits**. (A3013, ll. 5-8).

When the accused product is plugged into a conventional 15-amp circuit, up to four AC-powered lamps and one battery-powered lamp are disabled. (A3017) ("14-15 Amps – 4AC Lamps killed"). This means **at least five of sixteen lamps are always disabled during normal use with 15-amp circuits**, leaving only eleven or fewer total lamps operable to emit UV-C radiation to the room. (A3013, ll. 18; A3015, ll. 18-23). IPT employee Steve Fister further testified at his deposition that, in some situations, only ten of sixteen lamps are operable during normal use with 15-amp circuits. (A3015).

In addition to the deposition testimony and documentary evidence showing the IPT devices always operate during normal use with emitters disabled, Lumalier's expert Dr. Peters reviewed the source code for the lamp control software in the accused products, and he confirmed that up to six AC-powered lamps are disabled during normal operating conditions. (A3088, para. 203). IPT provided no expert testimony to contradict Dr. Peters' analysis of the control software source code relating to lamp operation.

It is simple physics that a sensor assembly above a disabled emitter cannot literally receive "radiation that is from the UV-C device directly." Because numerous emitters are disabled at all times during normal operation of the accused device, Lumalier contends at least one sensor on the accused IPT products positioned above one or more disabled emitters receives and measures only

reflected radiation. IPT disputes this factual assertion. However, a reasonable jury, when presented with both the deposition testimony of IPT engineer Steve Fister and Dr. Peters' expert analysis of the control software, could conclude that multiple emitters are disabled under normal operating conditions in the accused product and at least one emitter receives and measures only reflected radiation. The district court erred by not construing this disputed fact in favor of Lumalier as required at the summary judgment stage. *Anderson v. Liberty Lobby, Inc.*, 477 U.S. 242, 255 (1986) ("[T]he evidence of the non-movant is to be believed, and all justifiable inferences are to be drawn in his favor."); *SRI Intern. v. Matsushita Elec. Corp of Amer.*, 775 F.2d 1107, 1116 (Fed. Cir. 1985) ("[T]he district court must . . . resolve all doubt over factual issues in favor of the party opposing summary judgment.").

Additionally, Lumalier also presented evidence that users regularly operate the accused product when the batteries are in a low-power state or dead. (A3005, ll. 9). In such a state, the accused product will continue to operate without shutting down. (A3006, ll. 10-12; A4181, ll. 13-17). This leads to an operating condition where all four "battery-powered" lamps are disabled, in addition to the multiple "AC-powered" lamps that are disabled. (A2774, para. 204). In such circumstances, up to eight of sixteen emitters are disabled during operation of the accused devices. (A2774, para. 204). Dr. Peters concluded that, in such

circumstances, there would be no light from the emitters directly incident on the sensor assembly. As such, a factual dispute exists as to whether or not the accused products literally receive and measure only "radiation that is reflected from items in a room, as opposed to radiation that is from the UV-C device directly." Weighing this factual dispute in favor of Lumalier, it is clear that summary judgment of no literal infringement is inappropriate. *Anderson*, 477 U.S. at 255.

2. The Teflon Cap Blocks Radiation that is "From the UV-C Device Directly."

The accused IPT products also include sensor assemblies, each including a photodiode UV-C sensor, positioned facing outwardly from the IPT device to detect UV-C radiation that is reflected back to the device. (A2741-A2742, para. 64; A2743, para. 77). This is precisely the sensor configuration identified in the specification of the '424 and '177 Patents to provide the claimed inventions the ability to detect reflected radiation. (A62, col. 4, ll. 24-25) ("They [sensors] are oriented away from the UVAS, thus measuring the dose of UV-C reflected back to the unit.").

The accused IPT products also include an additional Teflon cover, or cap, located directly over the detection window of the photodiode UV-C sensor. (A2747, para. 99; A2749, para. 107; illustrations on A2783-A2784). The Parties dispute whether the Teflon cap prevents the sensor from receiving and measuring

"radiation that is from the UV-C device directly" as that term is used in the district court's negative limitation in its construction of "reflected radiation." (A21).

Independent Claims 3 and 14 of the '424 Patent are apparatus claims, each requiring a "radiation sensor" that receives reflected ultraviolet-C radiation. The district court's claim construction of "reflected ultraviolet-C radiation" includes "radiation that is reflected from items in the room as opposed to radiation that is from the UV-C device directly." (A21). The Parties specifically dispute whether the Teflon cap in the accused products prevents the sensor from receiving and measuring "radiation that is from the UV-C device directly."

Lumalier's expert Dr. Peters stated in his expert report that the "Teflon cap blocks all light emitted from the UV-C emitters from directly reaching the AGN chip within the Genicom photodiode UV-C sensor for measurement." (A2747-2749; A2752, para. 128, 131). IPT offered no expert testimony of its own to contradict this point. Based on the current record, even under the district court's erroneous claim construction, a reasonable jury could easily agree with Dr. Peters that the Teflon cap positioned over the photodiode UV-C sensor in the accused product **literally** blocks all "radiation that is from the emitter directly" from reaching the photodiode UV-C sensor.

With regard to Claim 3 of the '424 Patent, even under the district court's erroneous claim construction, a reasonable jury could conclude that the accused

IPT products literally "measure[] said [radiation that is reflected from items in the room as opposed to radiation that is from the UV-C device directly]" because the expert opinion of Dr. Peters reveals all radiation directly from the emitters is blocked by the Teflon cap before it reaches the photodiode UV-C sensor. (A2752, para. 128).

At a minimum, a genuine factual dispute relating to literal infringement exists due to the presence of the Teflon cap that blocks direct radiation, especially considering the district court's claim construction that excludes direct radiation. Moreover, at the summary judgment stage, the district court erred by not weighing this fact in favor of the non-moving party Lumalier. *SRI Intern.*, 775 F.2d at 1116.

B. The District Court Erred in Granting Summary Judgment of No Infringement Under the Doctrine of Equivalents.

The doctrine of equivalents is "designed to protect inventors from unscrupulous copyists and unanticipated equivalents." *Kinzenbaw v. Deere & Co.*, 741 F.2d 383, 389 (Fed. Cir. 1984). The doctrine of equivalents also prohibits one from avoiding infringement liability by making only "insubstantial changes and substitutions . . . which, though adding nothing, would be enough to take the copied matter outside the claim, and hence outside the reach of law." *Graver Tank & Mfg. Co. v. Linde Air Prods. Co.*, 339 U.S. 605, 607 (1950).

As noted by this Court, "[w]hether the substitute element (1) has substantially the same function as the recited element, (2) achieves that function in

substantially the same way, and (3) achieves substantially the same result are questions of fact." *Charles Mach. Works, Inc. v. Vermeer Mfg. Co.*, 723 F.3d 1376, 1380 (Fed. Cir. 2013) (reversing district court's grant of summary judgment of non-infringement because genuine issue of material fact under doctrine of equivalents precluded summary judgment).

The district court granted summary judgment of no infringement under the doctrine of equivalents without ever conducting any threshold factual inquiry into the insubstantial differences or function-way-result analyses set forth in *Graver Tank.* 339 U.S. 605. Instead, the district court summarily concluded Lumalier is not entitled to rely on the doctrine of equivalents based on an erroneous application of prosecution history estoppel and erroneous claim constructions.

1. <u>The Accused IPT Product is a Copy of the Lumalier Device.</u>

The accused IPT product is an attempted design-around of the '424 and '177 Patents. The facts show that Mark Statham, IPT's founder and "coincidentally" a former Lumalier distributor, obtained a physical sample of Lumalier's ultraviolet disinfection device before he stopped working for Lumalier. (A2990, para. 13-19; A2991, para. 14-20). Using Lumalier's device as a template, the evidence shows Mr. Statham undertook an elaborate scheme to use Lumalier's technology and build a competing product that he would later argue does not infringe the '424 and '177 Patents. (A4348-49).

The IPT products are configured to operate nearly identically to the invention of the ’424 and ’177 Patents, as well as to Lumalier’s device, especially with regard to sensor assembly location and orientation. The accused IPT products include an array of vertical UV-C lamps, or emitters, arranged in a circle with UV-C sensors located directly above the emitters. (A2780-81). The sensor assemblies taught in the Lumalier Patents and used in the accused IPT devices are both oriented such that they face outwardly into the room and detect radiation that is reflected back to the device. Both devices include control logic to sense radiation reflected back to the device and to terminate emission once a desired reflected radiation dose has been reached.

As taught in the Patents (and as done in the Lumalier device), IPT positioned the sensor assembly directly above the emitters to face outwardly toward the room for the specific purpose of receiving and measuring reflected radiation. However, IPT also slightly modified the Lumalier sensor for the attempted design-around of the ’424 and ’177 Patent’s claims. IPT positioned each sensor to include a five-degree downward tilt such that a small portion of emitted light is incident on the exterior of the sensor assembly. IPT also modified the sensors used in the Lumalier device by placing a Teflon cap over the detection window of the UV-C sensor.

2. Lumalier Presented Uncontroverted Evidence of Infringement under the Doctrine of Equivalents.

Lumalier has long contended that the accused IPT products not only literally infringe the asserted claims, but also infringe under the doctrine of equivalents. Lumalier's expert Dr. Peters concluded in his third expert report that the modified sensor assemblies in the accused IPT products perform substantially the same function in substantially the same way to achieve substantially the same result as the sensors identified in the '424 and '177 Patents. (A2776).

a. Substantially Same Function

Dr. Peters opined that both the claimed invention and the accused IPT device emit UV-C radiation outwardly into a room, monitor radiation reflected back to the device from the items in the room, and terminate emission after a target value has been reached. (A3000, ll. 10-12; A3001, ll. 8-12). IPT's sensor assembly, undeniably intended as a substitute for the sensor recited in the '424 and '177 Patent claims, performs the function of sensing radiation that is reflected back to the IPT device from items in a room. This is substantially the same function as the sensor in the claimed invention. (A62, col. 3, ll. 29-33).

b. Substantially Same Way

Dr. Peters also opined that the IPT device performs the desired function in substantially the same way as the claimed invention. The Patents teach use of a UV-C sensor mounted directly above the emitters facing outwardly toward the

room to measure radiation that is reflected back to the device from items in the room. (A62, col. 4, ll. 24-28). The IPT device also uses UV-C sensors mounted directly above the emitters, facing outwardly toward the room, to detect radiation that is reflected back to the device from items in the room. Thus, Dr. Peters concluded, the accused IPT products and the claimed invention both operate to perform the desired function – detection of radiation reflected back to the device – in substantially the same way, i.e. they both use UV-C sensors facing outwardly toward the room to detect UV-C radiation reflected back to the device. (A2787-88).

c. Substantially Same Result

Finally, Dr. Peters opined that the IPT substitute sensors produce substantially the same result as the sensors of the claimed invention. (A3000, ll. 10-12; A3001, ll. 8-14). The Patents teach the radiation sensors produce an output signal representative, at least in part, of the measured reflected UV-C radiation that is reflected from the items in the room. (A62, col. 4, ll. 25-27). This information about reflected radiation is then used to control the lamps. (A63, col. 5, ll. 18-25).

The output signal from the sensor assemblies in the IPT products includes data representative of the amount of radiation reflected back to the device from items in the room. Dr. Peters concluded the fact that the output signal in the accused IPT products may contain a baseline amount of direct radiation is

inconsequential, as that amount will be substantially constant. (A2688, ll. 11-22). It doesn't matter if that baseline amount due to direct radiation is 1% or 90% of the total output signal, the fact remains that the accused IPT products rely on reflected radiation in determining when to shut off the emitters. Dr. Peters concluded the sensor assemblies in the accused IPT products generate an output signal representative of measured reflected radiation (regardless of whether that signal also includes a baseline of direct radiation). (A2742; A2745, para. 85). Moreover, just as taught by the Patents, the evidence shows that the accused IPT products convert the output signal to a discrete value that is added over time and compared to a desired total endpoint. (A2772, para. 201). When the desired endpoint is reached, a command is given to turn off the emitters. (A2771, para. w). The '424 and '177 Patents teach substantially the same procedure, including comparison of the accumulated data to a constant target value and subsequent termination of UV-C emission once the target value is reached.

Without providing any contradictory expert testimony, IPT disputes the factual basis of Dr. Peters' expert opinion on infringement under the doctrine of equivalents. IPT contends its modified sensors perform a different function altogether – measurement of direct radiation. Lumalier strongly disputes this factual assertion as a red herring intended by IPT only to circumvent infringement under the doctrine of equivalents. IPT adds an additional and functionally

meaningless baseline value of direct radiation to the output signal. Direct radiation provides no guidance as to when to shut off the emitters. This highly material dispute between the Parties is a question of fact properly decided by the jury, not by the judge on summary judgment.

Further, IPT challenges the conclusion of Dr. Peters with regard to the "insubstantial" nature of the differences between the accused product and the claimed invention. IPT contends the amount of radiation incident on its sensor assemblies "directly from the emitters" is greater than the amount identified by Dr. Peters. Again, this is a factual dispute on a material issue – insubstantial differences – for determination by the jury, not by the judge at summary judgment.

The district court further erred by completely ignoring Lumalier's evidence of insubstantial differences. The district court failed to perform a function-way-result inquiry in its doctrine of equivalents analysis. (A54). The district court's order granting summary judgment of non-infringement under the doctrine of equivalents does not once acknowledge Lumalier's evidence that the substitute sensors in the accused IPT products perform substantially the same function in substantially the same way to achieve substantially the same result as the sensors in the claimed invention.

At the summary judgment stage, Lumalier's factual assertions regarding the function-way-result test must be accepted as true. *See, e.g., Charles Mach. Works*,

723 F.3d at 1380 ("For purposes of summary judgment, we must accept [patent holder's] factual assertions as true, and we hold that they raised genuine factual disputes material to the function-way-result inquiries."). Additionally, Lumalier provided an expert report concluding that the differences between the accused product and the claimed invention are insubstantial, and IPT disputed those conclusions. This evidence alone is sufficient to establish a genuine issue of material fact with regard to the doctrine of equivalents. *Brilliant Instruments, Inc. v. GuideTech, LLC*, 707 F.3d 1342, 1348 (Fed. Cir. 2013) ("[D]etailed application of the function-way-result test to the claim element and the allegedly equivalent feature of the accused product is sufficient to create a genuine issue of material fact for the jury to resolve."); *Crown Packaging Tech., Inc. v. Rexam Beverage Can Co.*, 559 F.3d 1308, 1315 (Fed. Cir. 2009) (reversing summary judgment of non-infringement under the doctrine of equivalents because expert report raised genuine issue of material fact relevant to function-way-result test).

Lumalier's doctrine of equivalents argument should be allowed to go to the jury, even if the district court's flawed claim construction is affirmed.

3. Prosecution History Estoppel Is Not Applicable in this Case.

Finally, the district court erred by concluding on summary judgment that prosecution history estoppel bars Lumalier's doctrine of equivalents infringement argument. (A54-55). Specifically, the district court concluded the doctrine of

equivalents is not applicable because of argument-based estoppel made during the prosecution of the '424 Patent. *Id.*

The district court's application of prosecution history estoppel is inappropriate in this case. This Circuit's case law is clear that "[t]o invoke argument-based estoppel, the prosecution history must evince a 'clear and unmistakable surrender of subject matter.'" *Eagle Comtronics v. Arrow Communication Labs.*, 305 F.3d 1303, 1316 (Fed. Cir. 2002) (internal citation omitted). Further, a prosecution argument that is amenable to multiple reasonable interpretations does not constitute "clear and unmistakable" surrender. *Cordis Corp v. Medtronic AVE, Inc.*, 339 F.3d 1352, 1369 (Fed. Cir. 2003).

Notably, the district court's Order granting summary judgment does not identify any specific statements or quotes in the prosecution record that allegedly amount to estoppel. Rather, the district court generalizes the prosecution record in its own words. (A53-55). As a threshold matter, it was error for the district court to grant summary judgment of no infringement under the doctrine of equivalents based on prosecution history estoppel without at least identifying in the prosecution record the specific statements that allegedly amount to clear and unambiguous surrender of claim scope.

As noted above in Section I, Applicant distinguished three cited prior art references during prosecution of the '424 Patent: the Cimino reference, the

German reference, and the Owesen reference. IPT argued, and the district court agreed, that Applicant's arguments surrendered any and all embodiments that include a sensor capable of receiving both direct and reflected radiation. (A53). However, in determining the scope of precisely what was surrendered, the district court failed to properly consider the entirety of the prosecution record, including all of Applicant's arguments and the prior art.

a. The Initial Rejection of Claims 1-4 of the '424 Patent.

The patent application that led to the '424 Patent was originally filed on September 19, 2000 having four claims, with Claims 1 and 3 being the only independent Claims. The USPTO issued a first Office action on April 8, 2003 rejecting all four claims. Claims 1 and 2 were rejected under Section 103 based on a combination of all three prior art references, and Claims 3 and 4 were rejected under Section 102(b) based on the Owesen reference.

In response to the initial Office action, Applicant added new Claims 5-20, with new Claims 5 and 12 being independent. Both of the newly added independent Claims 5 and 12 differed from the original independent Claims in that the newly added independent Claims each required "at least one sensor" that "receives **only** reflected ultraviolet-C radiation . . . ." (A1012-13, para. 3; A1014,

ll. 3-13).[2] Importantly, Claims 1 and 3 as originally presented, and as ultimately issued in the '424 patent, do not require a sensor to receive or measure "**only** reflected ultraviolet-C radiation." (A63). If Applicant had intended to limit the scope of Claims 1 and 3 of the '424 patent to "**only** reflected ultraviolet-C radiation," Applicant would have amended those claims to add the word "only" as included in the newly added Claims 5-20 added in the first Office action Response.

b. Applicant's Prosecution Arguments.

In response to the initial Office action, Applicant argued that the cited references did not teach all the limitations of the pending and newly added Claims. Those arguments form the basis of IPT's prosecution history estoppel argument. Lumalier contends the prosecution arguments do not amount to "clear and unmistakable" surrender of all sensor embodiments that receive both direct and reflected radiation.

The district court and IPT take isolated statements from the prosecution record out of context in support of the estoppel argument in violation of this Court's general rule that "the entire record must be analyzed using an objective standard to determine what has been surrendered during prosecution." *Loral Fairchild Corp. v Sony Corp.*, 181 F.3d 1313, 1327 (Fed. Cir. 1999). The district court's reliance on isolated statements from the prosecution history, divorced

[2] Claims 5 and 12 added in the May 13, 2003 Office action Response correspond to issued Claims 6 and 14 in the '424 Patent.

completely from any analysis of the scope of the prior art, was improper. When Applicant's arguments are properly reviewed in context of the entire prosecution record, prosecution history estoppel cannot be justified.

Looking to the entire prosecution record, Applicant's arguments clarified that Cimino and the German reference taught UV sensors positioned at a location remote from the UV emitters such that the sensors directly faced back toward the UV emitters and received only direct radiation. (A1010). As such, Applicant argued the sensors in Cimino and the German reference **were not capable** of receiving or measuring any reflected radiation from the target items. For example, in distinguishing the German reference, Applicant noted "[i]t is clear from the structure of this device that the sensor 12 is positioned to receive direct radiation from the emitters, since the sensor is **placed remotely from the emitters** . . . ." (A1010, ll. 2-4). Applicant further noted "[f]or the UV sensor of the German patent to receive reflected UV radiation from the area being sterilize[d] . . . the sensor would have to be positioned within the container, and not externally to the container." (A1010, ll. 6-8). Thus, it is reasonable to conclude Applicant was distinguishing the German reference on the basis that, due to its orientation and placement, the UV sensor in the German reference was physically incapable of detecting any reflected radiation at all from the target disinfection surfaces.

Similarly, in distinguishing Cimino, Applicant stated "[a]s with the German patent, these detectors [of Cimino] are positioned **near a wall of the housing 100, while the bulbs 10 are more centrally located**." (A1010, ll. 9-11). Applicant's arguments distinguished the prior art based on where the sensors were located and consequently whether the sensors were able to detect **any** reflected radiation. The sensors in Cimino and the German reference were clearly positioned at locations remote from the emitters and facing back toward the emitters such that only direct radiation could be detected and measured. The accused IPT products do not practice this prior art, but rather position the sensors facing outwardly, as taught in the '424 Patent, so that the sensors are capable of receiving and measuring radiation reflected back to the sensors from the targeted disinfection surfaces.

c. The Scope of Surrender is Limited.

If any content was surrendered during prosecution of the '424 Patent, it was the embodiments of Cimino and the German reference that placed sensors remote from the emitters and facing back toward the emitters such that the sensors could detect only direct radiation. However, the scope of surrender based on Applicant's arguments in the first Office action Response does not extend to all embodiments with a sensor that can receive both direct and reflected radiation. This restrictive interpretation of the prosecution history is not supported by the entirety of the arguments presented by Applicant.

IPT additionally points to statements made by Applicant concerning the Owesen reference as evidence further supporting prosecution history estoppel. However, Owesen does not teach the location of any UV-C sensor. The Examiner even acknowledged this fact in the first Office action, stating "Owesen fails, however, to disclose the implementation of sensors for assuring that all surfaces have been appropriately radiated." (A996). The "UV probe" item identified in Owesen is not shown in the drawings, and its location is not described in the specification. Thus, it is unclear where the UV-C probe in Owesen is positioned. It is equally unclear from Owesen if the UV-C probe receives only direct radiation, receives only reflected radiation, or receives a mixture of direct and reflected radiation. In the face of such ambiguity in the teaching of the prior art reference, Applicant's statements with regard to the Owesen reference cannot constitute a "clear and unmistakable" disclaimer of the accused IPT products. The sensor location in Owesen is unknown.

Lumalier readily concedes that the Applicant, as do most applicants, may have surrendered some subject matter during prosecution of the '424 Patent. As is so often the case, such surrender would include the embodiments taught in the prior art – in this instance Cimino, the German reference, and Owesen. But, the district court failed to recognize that the surrendered content does not include IPT's design-around. Nowhere does the surrendered content of the prior art teach

a sensor that receives both reflected and direct radiation. IPT's attempted design-around infringes.

Applicant's prosecution record argument should be viewed in context by considering the exact scope of the prior art Applicant was distinguishing. *Pall Corp. v. PTI Tech. Inc.*, 259 F.3d 1383, 1393 (Fed. Cir. 2001) (considering teachings of of prior art in analyzing the scope of argument-based surrender). This point is especially relevant in this litigation because IPT has repeatedly attempted to mislead the Court into believing IPT's product escapes infringement by merely practicing the Owesen prior art reference. (*See, e.g.*, A1379, A1383). IPT, however, ignores the fact that the location of the UV probe is not taught anywhere in Owesen, and it is not clear from Owesen whether the UV probe is able to receive **any** reflected radiation at all.

If anything, the only things disclaimed would be embodiments of Cimino and the German reference with remote sensors facing the emitters that receive only direct radiation. If IPT's accused products were to position the sensor assemblies remote from the emitters and facing back toward the emitters to receive only direct radiation, as taught in Cimino and the German reference, Lumalier would not contest prosecution history estoppel in this case. However, IPT's attempted design-around positions its sensors immediately above the emitters, facing outwardly toward the room, for the specific purpose of receiving and measuring

reflected radiation. This embodiment was not clearly and unambiguously surrendered during prosecution of the ’424 Patent, and the district court erred in concluding prosecution history estoppel warrants summary judgment of no infringement under the doctrine of equivalents in this case.

CONCLUSION

For the foregoing reasons, Defendant-Appellant Lumalier respectfully requests that the Court (1) reverse the district court's erroneous claim constructions as a matter of law and order new constructions for the claim terms "reflected ultraviolet-C radiation" and "measuring" consistent with plain and ordinary meaning as proposed by Lumalier; (2) reverse the district court's order granting summary judgment of no literal infringement; (3) reverse the district court's order granting summary judgment of no infringement under the doctrine of equivalents; and (4) remand this case to the district court for further proceedings on the issues of literal infringement and infringement under the doctrine of equivalents.

Respectfully submitted,

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Dated: December 23, 2013

CERTIFICATE OF COMPLIANCE

1. This brief complies with the type-volume limitation of Federal Rule of Appellate Procedure 32(a)(7)(B) or Federal Rule of Appellate Procedure 28.1(e).

- This brief contains 10,181 words, excluding the parts of the brief exempted by Federal Rule of Appellate Procedure 32(a)(7)(B)(iii).

2. This brief complies with the typeface requirements of Federal Rule of Appellate Procedure 32(a)(5) or Federal Rule of Appellate Procedure 28.1(e) and the type style requirements of Federal Rule of Appellate Procedure 32(a)(6).

- This brief was prepared in a proportionally spaced typeface using Microsoft Word Standard 2010 in Size 14 Times New Roman font.

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CERTIFICATE OF SERVICE

I certify that a copy of the foregoing Appellant's Brief and following Addendum were served on all counsel of record on December 23, 2013 by electronic means via CM/ECF of the Court of Appeals for the Federal Circuit, including:

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ADDENDUM

ADDENDUM TABLE OF CONTENTS

UNITED STATES DISTRICT COURT
EASTERN DISTRICT OF MICHIGAN
SOUTHERN DIVISION

INFECTION PREVENTION TECHNOLOGIES, LLC,

Plaintiff,

vs

Case No: 10-12371
Honorable Victoria A. Roberts

LUMALIER CORPORATION,

Defendant.
_____/

ORDER ON CLAIM CONSTRUCTION

I. INTRODUCTION

Plaintiff Infection Prevention Technologies, LLC ("IPT") brought this suit against Defendant Lumalier Corporation ("Lumalier") seeking, among other relief, a declaration that its device does not infringe Lumalier's patents, both titled "Ultraviolet Area Sterilizer And Method Of Area Sterilization Using Ultraviolet Radiation," U.S. Patent No. 6,656,424 ("'424 patent") and U.S. Patent No. 6,911,177 ("'177 patent") (collectively, "the patents"). The '177 patent is a continuation-in-part application of the '424 patent, and, therefore, includes the same disclosures as the '424 patent. Lumalier filed counterclaims against IPT for infringement of the patents.

On July 24, 2012, the Court held a hearing in accordance with *Markman v. Westview Instruments*, 52 F.3d 967 (Fed. Cir. 1995) (en banc), *aff'd* 517 U.S. 370 (1996). The parties submitted extensive written briefs in support of their positions. In this Order, the Court construes ten disputed claim terms identified by the parties.

The Court's construction is set forth in Appendix A.

II. BACKGROUND

A. The Technology of the Patents

The patents are directed to a method and device for sterilizing rooms and similar enclosed areas. (Doc. 53-2, '424 patent, col. 1, ll. 14-15) The invention addresses the problem of nonsocomial, or hospital acquired, infections. (*Id.*, col. 1, ll. 19-20) Nonsocomial infections are both common and costly: a study of such infections in the cardiac surgery unit of a major hospital revealed an infection rate of 27.3% which more than doubled the mortality rate for afflicted patients. (*Id.*, col. 1, ll. 18-23) Moreover, evidence exists that the particular hospital environment contributes to the spread of these dangerous infections by harboring virulent strains of bacteria, fungi, and viruses. (*Id.*, col. 1, ll. 48-50) Other factors that contribute to these infections include overuse of antibiotics and poor personal hygiene. (*Id.*, col. 1, ll. 45-47)

Attempts to eradicate these contaminants in the past -- including use of topical antiseptics and fumigation with formaldehyde gas -- varied greatly in success. (*Id.*, col. 1, ll. 53-64) These methods also have notable drawbacks: topical antiseptics cannot penetrate electronics without causing damage, while gas is time-consuming, dangerous for workers, and environmentally unwise. (*Id.*)

The "Brief Summary Of The Invention" describes an ultraviolet area stabilizer ("UVAS") that sterilizes a room by emitting ultraviolet light. (*Id.*, col. 2, ll. 15-42) The UVAS can be either mobile or stationary and is placed in a room such as an operating room or intensive care unit where concern exists about the presence of pathogenic

bacteria. (*Id.*, col. 2, ll. 16-21). The device works by emitting ultraviolet-C ("UV-C") light, a high frequency wavelength of light within the ultraviolet band that is effective at killing bacteria. (*Id.*, col. 2, ll. 3-5, 25-26). In the words of the Summary:

> After the bulbs have reached a steady state of output, an array of UV-C sensors scan the room, and determine the darkest area, or the area reflecting the lowest level of UV-C back to the sensors. A BASIC Stamp contained in the device calculates the time required to obtain a bactericidal dose of UV-C reflected back from the darkest area. The UVAS transmits the calculated dose of UV-C, as well as other monitoring information, to the remote control where it is displayed to the operator. Once a bactericidal dose has been reflected to all the sensors, the unit notifies the operator and shuts down. By relying on reflected doses rather than direct exposure, the UVAS is able to sterilize or sanitize all surfaces within the room that are within view of an exposed wall or ceiling. The pathogenic bacteria in the room have been effectively eliminated.
>
> (*Id.*, col. 2, ll. 28-42)

B. Procedural History of the Patents

On September 19, 2000, inventor Jeffrey L. Deal filed the application, U.S. Patent Application Serial No. 09/665,151, which later issued as the '424 patent. (Doc. 53-4, IPT's Claim Const. Br., Ex. C, pp. 15-37) On April 8, 2003, the patent examiner rejected all claims over the prior art. (*Id.*, Ex. C, pp. 46-52) Specifically, claims 1 and 2 of the patent were rejected as unpatentable over Owesen, U.S. Patent No. 5,891,399 A, in view of German patent DE 29812427 and Cimino et al., U.S. Patent No. 6,433,343 B1. (*Id.*, Ex. C, p. 49) Claims 3 and 4 were rejected as being anticipated by Owesen. (*Id.*, Ex. C, p. 48)

In rejecting all claims of the '424 patent, the examiner discussed the prior art. Owesen "teaches a method of sterilizing an enclosed area (a room) with UV-C radiation" and "desires to achieve complete irradiation of all exposed surfaces in the room." (*Id.*, Ex. C, p. 49) German patent DE '427 "teaches the sterilization of an

enclosed area wherein a sensor is used to assure that the amount of radiation necessary for achieving sterilization is received by the area surfaces." (*Id.*) In view of DE '427, the examiner continued: "It would have been obvious to one of ordinary skill in the art to employ a sensor in the method of Owesen, as Owesen repeatedly teaches than an object of the invention is to achieve complete irradiation of all room surfaces." (*Id.*, Ex. C, p. 49) Lastly, the examiner found that "Cimino et al . . . teaches that it is known in the art to use a plurality of sensors . . . located at multiple points within a chamber in order to ascertain when the desired amount of UV radiation has been received in all portions of the chamber. At such a point, a feedback control shuts off the radiation means. (*Id.*)

Prior to filing a written response to the examiner's rejection, on May 13, 2003 applicant's attorney Bill Killough conducted a telephonic interview with the primary examiner, Leigh McKane. In the interview, the parties discussed the prior art that was the basis for the examiner's rejection. The examiner memorialized the substance of the interview as follows:

> Mr. Killough explained that the present invention measures reflected radiation, as opposed to emitted radiation, in order to ascertain sterilization effectiveness. The Examiner agreed that neither Cimino et al nor DE 29812427 teach measuring reflected radiation. However, since the sensor of Owesen is located on the housing, it would inherently measure some reflected radiation, whether intended or not. Mr. Killough will file a response addressing these issues.
>
> (*Id.*, Ex. C., Interview Summary, p. 71)

On May 21, 2003, applicant filed a written response to further distinguish the prior art on the grounds that the '424 patent requires measuring reflected radiation as opposed to emitted radiation. (*Id.*, Ex. C, Response to Official Action Dated April 8,

2003, pp. 53-70) Describing this "critical" distinction, applicant stated:

> Sensors that measure reflected radiation, rather than measuring UV-C radiation that is emitted directly from the emitters, control the operation of the device. Operational control by measuring reflected radiation is novel and unique to the device. This feature is critical to effective disinfection of an area such as a room. (*Id.*, Ex. C., p. 61)

Applicant maintained that each of the rejected claims requires, among other things, that the device receive and measure *reflected* radiation rather than directly emitted radiation. For example, applicant pointed to one of the requirements of claim 1, "measuring a reflection of ultraviolet-C radiation from each of multiple points within (an) enclosed area." (*Id.*, Ex. C, p. 62) Applicant then argued that "[t]he Official Action does not state how the German patent or *Cimino et al.* measure "a reflection of ultraviolet-C radiation" as required by Claim 1." (*Id.*) Applicant further stated that this limitation is "material to the present invention." (*Id.*)

Applicant then distinguished the prior art in that each included sensors which received direct radiation rather than reflected radiation. To distinguish the German patent DE '427, applicant wrote:

> It is clear from the structure of this device that the sensor is positioned to receive direct radiation from the emitters, since the sensor is placed remotely from the emitters, and in direct line of sight from the upper portion of the emitters. The position of the sensor is such that it would not receive radiation reflected from inside the container which is being sterilized. For the UV sensor of the German patent to receive reflected UV radiation from the area being sterilize (sic), which is the container, the sensor would have to be positioned within the container, and not externally to the container.
>
> (*Id.*, Ex. C, p. 63)

Applicant similarly distinguished Cimino on the grounds that its reflectors could not measure reflected radiation:

> As with the German patent, these detectors are positioned near a wall of the housing, while the bulbs are more centrally located. The detectors are in a direct line of sight from the bulbs, so that they receive direct radiation. *Cimino et al.* do not position the detectors for "measuring a reflection of ultraviolet-C radiation" as required by Claim 1.
>
> (*Id.*)

Applicant made a slightly different argument to distinguish Owesen. The examiner had rejected claims 3 and 4 of the patent as being anticipated by Owesen. Anticipation means that all limitations of the claim are present in the prior art. To overcome anticipation, applicant essentially argued that even though the Owesen sensor received some reflected radiation, it also received directly emitted radiation. Therefore, the Owesen sensor could not measure reflected radiation because the sensors could not distinguish between direct versus emitted radiation. Applicant stated in its response:

> The Official Action fails to explain how *Owesen* meets the limitation of element (c) of Claim 3 that the radiation receiver "receives reflected ultraviolet-C radiation" and that the "receiver measures said reflected ultraviolet-C radiation." . . . It is apparent that this UV probe does not receive or measure reflected ultraviolet-C radiation. Even if there is incidental reflected radiation that is received by the probe (which is not indicated by *Owesen*), there is no indication in the reference that the reflected radiation is measured. A mixture of reflected and direct measurement by an individual sensor negates the ability to determine adequate exposure and decontamination in a changing environment.
>
> (*Id.*, Ex. C, pp. 64-65)

On June 25, 2003, the examiner found all claims of the '424 patent allowable as amended. (*Id.*, Ex. C, Notice of Allowability, pp. 72-78)

C. The Claims of the Patents

The '424 patent has four independent claims: claims 1, 3, 6, and 14. Claims 1 and 6 are representative and are reproduced here by way of example.

Claim 1 provides:

1. A method of *sterilizing* an area using ultraviolet light, comprising the steps of:

(a) causing ultraviolet-C radiation to be emitted within an enclosed area;

(b) *measuring* a *reflection of ultraviolet-C radiation* from each of multiple points within said enclosed area;

(c) *calculating* the ultraviolet-C radiation level necessary to *sterilize* said enclosed area and comparing it with the measured *reflected ultraviolet-C radiation*;

(d) terminating the emission of ultraviolet-C radiation after determining that the required minimum ultraviolet-C radiation has been *reflected* from each of said multiple points within said enclosed area.

('424 patent, col. 5, ll. 50-63 (disputed claim terms emphasized))

Claim 6 provides:

6. A method of disinfecting an area using ultraviolet radiation, comprising the steps of:

(a) causing an emission of ultraviolet-C radiation within an enclosed area;

(b) providing at least one sensor that receives only reflected ultraviolet-C radiation received from said emission of ultraviolet-C radiation;

(c) measuring a level of reflected ultraviolet-C radiation received by said at least one sensor; and

(d) terminating the emission of ultraviolet-C radiation upon determining that a cumulative level of reflected ultraviolet-C radiation has been received by at least one sensor.

(*Id.*, col. 6, ll. 20-33)

The '177 patent, which is a continuation-in-part of the '424 application, has three independent claims: claims 1, 7, and 11. Claims 1, 7, and 11 of the '177 patent are nearly identical to claims 1, 3, and 6 of the '424 patent and will not be reproduced here.

III. THE LAW OF CLAIM CONSTRUCTION

An analysis of a patent infringement claim involves two steps. The first step is "determining the meaning and scope of the patent claims asserted to be infringed." *Markman v. Westview Instruments, Inc.*, 52 F.3d 967, 976 (Fed. Cir. 1995). The second step is "comparing the properly construed claims to the devices accused of infringing." *Id.* The Court is called upon to perform the first step, commonly referred to as claim construction.

The claims of a patent "define the invention which the patentee is entitled to exclude others from practicing." *Am. Calcar, Inc. v. Am. Honda Motor Co., Inc.*, 651 F.3d 1318, 1336 (Fed. Cir. 2011) (citing *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312 (Fed. Cir. 2005) (en banc)). Thus, the purpose of claim construction "is to determine the meaning and scope of the patent claims that the plaintiff alleges have been infringed." *Every Penny Counts, Inc. v. Am. Express Co.*, 563 F.3d 1378, 1381 (Fed. Cir. 2009). Claim construction is a question of law for the court. *Markman*, 52 F.3d at 979; *Cybor Corp. v. FAS Technologies, Inc.*, 138 F.3d 1448, 1456 (Fed. Cir. 1998) (en banc) (reaffirming that claim construction is purely a question of law for the court).

The starting point for claim construction analysis is the words of the claims themselves. *Vitronics Corp. v. Conceptronic, Inc.*, 90 F.3d 1576, 1582 (Fed. Cir. 1996) ("First, we look to the words of the claims themselves, both asserted and nonasserted, to define the scope of the patented invention."); *Innova/Pure Water, Inc. v. Safari Water Filtration Sys., Inc.*, 381 F.3d 1111, 1116 (Fed. Cir. 2004) ("[A] claim construction analysis must begin and remain centered on the claim language itself, for that is the language the patentee has chosen to particularly point out and distinctly claim the subject matter which the patentee regards as his invention.") (internal quotations and

citations omitted).

Claim terms "'are generally given their ordinary and customary meaning.'" *Phillips*, 415 F.3d at 1312 (citing *Vitronics*, 90 F.3d at 1582); *Elbex Video, Ltd. v. Sensormatic Elecs. Corp.*, 508 F.3d 1366, 1371 (Fed. Cir. 2007) ("Claim terms are entitled to a 'heavy presumption' that they carry their ordinary and customary meaning to those skilled in the art in light of the claim term's usage in the patent specification."). "[T]he ordinary and customary meaning of a claim term is the meaning that the term would have to a person of ordinary skill in the art in question at the time of the invention." *Phillips*, 415 F.3d at 1313.

In some cases, the ordinary meaning of a claim term as understood by a person of skill in the art may be readily apparent even to lay persons, such as judges. In these cases, claim construction "involves little more than the application of the widely accepted meaning of commonly understood words." *Id.* at 1314. Under these circumstances, general purpose dictionaries may be helpful. *Id.* In many cases, though, the meaning of a claim term as understood by a person of skill in the art is not readily apparent to those unskilled in the art. When this is the case,

> the court looks to those sources available to the public that show what a person of skill in the art would have understood disputed claim language to mean. Those sources include the words of the claims themselves, the remainder of the specification, the prosecution history, and extrinsic evidence concerning relevant scientific principles, the meaning of technical terms, and the state of the art.
>
> *Id.* (internal quotations and citations omitted).

As a starting point, the claims themselves provide substantial guidance as to the meaning of particular claim terms. First, the context in which a particular term is used within a claim can be instructive. For example, in *Phillips*, the court was asked to

construe the term "steel baffles." The Federal Circuit noted that the claim term "steel baffles" strongly implied "that the term 'baffles' does not inherently mean objects made of steel." *Id.* at 1314. Second, differences among claims can be a helpful guide in understanding the meaning of claim terms. *Id.* This is known as claim differentiation. "For example, the presence of a dependent claim that adds a particular limitation gives rise to a presumption that the limitation in question is not present in the independent claim." *Id.* at 1314-15.

The claims, however, do not stand alone; they must be read in view of the specification. *Id.* at 1315. "The specification 'is always highly relevant to the claim construction analysis. Usually, it is dispositive; it is the single best guide to the meaning of a disputed term.'" *Id.* (quoting *Vitronics*, 90 F.3d at 1582). The importance of the specification derives from its statutory role: 35 U.S.C. § 112 requires that the specification describe the claimed invention in "full, clear, concise, and exact terms." *Id.* Moreover, the patentee may act as its own lexicographer in the specification, giving a special definition to a claim term that differs from the meaning it would otherwise possess. *Id*. at 1316. Or, the specification "may reveal an intentional disclaimer, or disavowal, of claim scope by the inventor." *Id.*

When consulting the specification, though, the court must be mindful not to read limitations from the specification into the claims. *Comark Communications v. Harris Corp.*, 156 F.3d 1182, 1186 (Fed. Cir. 1998). The distinction between reading the claims in light of the specification and reading a limitation from the specification into the claim is often quite delicate. *Id.* The court must be careful to avoid the latter while doing the former. *See Sjolund v. Musland*, 847 F.2d 1572, 1581 (Fed. Cir. 1988)

("While . . . claims are to be interpreted in light of the specification and with a view to ascertaining the invention, it does not follow that limitations from the specification may be read into the claims."); *Texas Inst., Inc. v. United States Int'l Trade Comm'n*, 805 F.2d 1558, 1563 (Fed. Cir. 1986) ("This Court has cautioned against limiting the claimed invention to preferred embodiments or specific examples in the specification.").

Another source of intrinsic evidence the Court may consider is the patent's prosecution history. The prosecution history "consists of the complete record of the proceedings before the PTO and includes the prior art cited during the examination of the patent." *Phillips*, 415 F.3d at 1317. Like the specification, the prosecution history "can often inform the meaning of the claim language by demonstrating how the inventor understood the invention and whether the inventor limited the invention in the course of prosecution, making the claim scope narrower than it otherwise would be." *Id.* (citing *Vitronics*, 90 F.3d at 1582-83). Claim scope may be limited or disavowed through the doctrine of prosecution disclaimer where "a patentee unequivocally imparted a novel meaning to those [claim] terms or expressly relinquished claim scope during prosecution . . . ." *Omega Engineering, Inc. v. Raytek Corp.*, 334 F.3d 1314, 1323 (Fed. Cir. 2003). However, the Federal Circuit cautioned that "because the prosecution history represents an ongoing negotiation between the PTO and the applicant, rather than the final product of that negotiation, it often lacks the clarity of the specification and thus is less useful for claim construction purposes." *Phillips*, 415 F.3d at 1317.

Lastly, courts are authorized to rely on extrinsic evidence, "which consists of all evidence external to the patent and prosecution history, including expert and inventor testimony, dictionaries, and learned treatises." *Id.* For a variety of reasons, extrinsic

evidence is less reliable than intrinsic evidence. *See Id.* at 1318-19 ("[U]ndue reliance on extrinsic evidence poses the risk that it will be used to change the meaning of claims in derogation of the indisputable public records consisting of the claims, the specification and the prosecution history, thereby undermining the public notice function of patents.") (internal quotations and citations omitted). Therefore, the court should look *first* to the intrinsic evidence. *Vitronics*, 90 F.3d at 1582. If the court then chooses to consult extrinsic evidence, it must be "considered in the context of the intrinsic evidence." *Phillips*, 415 F.3d at 1319. Extrinsic evidence should only be used by the court to enhance its understanding of the technology. *EMI Group N. America, Inc. v. Intel Corp.*, 157 F.3d 887, 892 (Fed. Cir. 1998). "[It] cannot be used to contradict the established meaning of the claim language." *Gart v. Logitech*, 254 F.3d 1334, 1340 (Fed. Cir. 2001).

IV. ANALYSIS

The parties dispute the meaning of ten terms. The Court considers these in turn.

A. "a reflection of ultraviolet-C radiation" / "reflected ultraviolet-C radiation"

The asserted claims 1, 3, 6, and 14 of the '424 patent and claims 1 and 11 of the '177 all include the term "a reflection of ultraviolet-C radiation" or the equivalent term "reflected ultraviolet-C radiation."

IPT maintains that the Court must construe the term as "*radiation that is reflected from items in an area as opposed to radiation that is from the UV-C device directly*." (IPT's Claim Constr. Br. at 7) IPT says its construction is not based on a prosecution history disclaimer of the ordinary meaning of reflected radiation, but on the ordinary

meaning as informed by the specification and the prosecution history. (IPT's Resp. to Lumalier's Claim. Constr. Br. at 3, n.1)

Lumalier states that the term should be given its ordinary and customary meaning, which it says is "*any ultraviolet-C radiation that has bounced off any surface*." (Lumalier's Claim Const. Br. at 7) In support of its position, Lumalier cites *Phillips*, which states: "In some cases, the ordinary meaning of claim language as understood by a person of skill in the art may be readily apparent even to lay judges, and claim construction in such cases involves little more than the application of the widely accepted meaning of commonly understood words." 415 F.3d at 1314. Lumalier says that nothing in the specification or prosecution history provides any reason for the Court to stray from the plain and ordinary meaning. (*Id.* at 8) Further, Lumalier says that "reflected radiation" and "measure" should be read together to encompass "not only measuring reflected radiation, but also allowing the device or method to measure direct radiation." (Lumalier's Rebuttal Br. at 13)

1. An Analysis of the Claims in Light of the Specification Favors IPT's Construction

The Court must begin its analysis with a review of the claim language itself. *Vitronics*, 90 F.3d at 1582. Each of the asserted claims explicitly provides that the device measures *reflected* radiation, not merely radiation. IPT argues that Lumalier's proposed construction improperly seeks to read "reflected" out of the claims. IPT states:

> The asserted claims recite "measuring *reflected* radiation." If the patentee desired claims which cover measurement of any type of radiation, reflected or otherwise, the patentee could have simply used the phrase "measuring radiation." The patentee did not use such language and is bound to the precise

words used in his claims.

(IPT's Claim Const. Br. at 7)

The Court finds IPT's argument persuasive. Any construction that would render superfluous the claim language "reflected" is disfavored. *See Digital-Vending Services Int'l, LLC v. Univ. of Phoenix, Inc.*, 672 F.3d 1270, 1275 (Fed. Cir. 2012) (finding construction that rendered certain claim language surplusage was "contrary to the well-established rule that 'claims are interpreted with an eye toward giving effect to all terms in the claim.'") (quoting *Bicon, Inc. v. Straumann Co.*, 441 F.3d 945, 950 (Fed. Cir. 2006)); *see also Phillips*, 415 F.3d at 1314 (use of term "steel baffles" strongly implied that baffles are not inherently made of steel); *Fifth Generation Computer Corp. v. Int'l Bus. Machines Corp.*, 416 Fed. App'x 74, 79 (Fed. Cir. 2011) ("Th[e] [public] notice function would be undermined, however, if courts construed claims so as to render characteristics specifically described in those claims superfluous. As such, we construe claims to give effect to all of their terms." (internal citation omitted)). Thus, the court must construe the disputed language to give full effect to the term "reflected."

The specification provides guidance on the proper construction of reflected radiation. *See Vitronics*, 90 F.3d at 1582 (the specification is "the single best guide to the meaning of a disputed term."); *see also Adams Respiratory Therapeutics, Inc. v. Perrigo Co.*, 616 F.3d 1283, 1290 (Fed. Cir. 2010) ("Claim terms are not construed in a vacuum divorced from the specification."). Here, the specification explicitly states that reflected radiation is *not* meant to encompass directly emitted radiation. The Abstract explains: "By relying on **reflected doses rather than direct exposure**, the UVAS is able to sterilize or sanitize all surfaces within the room that are within view of an

exposed wall or ceiling." ('424 patent, Abstract (emphasis added)) This exact language is repeated in the Summary of the Invention. (*Id.*, col. 2, ll. 38-40) The specification also repeatedly describes "reflected radiation" as radiation reflected "back to the device." IPT identifies six passages in the specification where radiation is described as being "reflected back." (*Id.*, Abstract; col. 2, ll. 27-42; col. 3, ll. 29-33; col. 4, ll. 25, 33-35; col. 5, ll. 20-25) In addition, the specification explains that the sensors, because of their position on the device, are only capable of measuring reflected radiation as opposed to direct radiation. The relevant portion reads: "[The sensors] are oriented away from the UVAS, thus measuring the dose of UV-C reflected back to the unit." (*Id.*, col. 4, ll 24-25)

Thus, the specification explicitly disavows any construction of reflected radiation that would include radiation directly emitted from the device. "'Where the specification makes clear that the invention does not include a particular feature, that feature is deemed to be outside the reach of the claims of the patent, even though the language of the claims, read without reference to the specification, might be considered broad enough to encompass the feature in question.'" *Thorner v. Sony Comp. Ent. Am. LLC*, 669 F.3d 1362, 1366 (Fed. Cir. 2012) (quoting *SciMed Life Sys., Inc. v. Advanced Cardiovascular Sys., Inc.*, 242 F.3d 1337, 1341 (Fed. Cir. 2001)).

The specification defines both what "reflected radiation" is, and what it is not. It *is not* radiation that is directly emitted from the device; it *is* radiation that is "reflected back" to the device. Lumalier's proposed construction does not take into account this limitation. As IPT explains:

Construing "reflected radiation" to mean "any ultraviolet-C radiation that bounces

> off any surface" as Lumalier suggests, is inconsistent with the intrinsic evidence. If reflected radiation could come from the UV-C device as Lumalier's construction allows since the UV-C device is a surface, the "critical" aspect of the invention is eliminated from the invention.
>
> (IPT's Claim Constr. Br. at 9)

In sum, reading the entire specification together with the claim language favors IPT's construction.

2. The Prosecution History Favors IPT's Construction

All of the claims of the '424 patent were initially rejected over the prior art. *See supra* Part II.B. In order to distinguish the invention from the prior art of record, applicant argued that the present invention measures only reflected radiation as opposed to emitted radiation. Applicant is now bound by these representations. *See Ballard Medical Prods. v. Allegiance Healthcare Corp.*, 268 F.3d 1352, 1359 (Fed. Cir. 2001) ("An inventor may use the specification and prosecution history to define what his invention is and what it is not–particularly when distinguishing the invention over prior art."); *Cybor Corp.*, 138 F.3d at 1457 ("[P]ositions taken before the PTO may bar an inconsistent position on claim construction . . . .").

The Federal Circuit has held that "'claims may not be construed one way in order to obtain their allowance and in a different way against accused infringers.'" *Spectrum Int'l, Inc. v. Sterilite Corp.*, 164 F.3d 1372, 1379 (Fed. Cir. 1998) (quoting *Southwall Tech., Inc. v. Cardinal IG Co.*, 54 F.3d 1570, 1576 (Fed. Cir. 1995)). This rule protects the public notice function of the patent prosecution process. The Federal Circuit explained:

> That explicit arguments made during prosecution to overcome prior art can lead to narrow claim interpretations makes sense, because the public has a right to

> rely on such definitive statements made during prosecution. Indeed, by distinguishing the claimed invention over prior art, an applicant is indicating what the claims do not cover. Accordingly, claims may not be construed one way in order to obtain their allowance and in a different way against accused infringers.

Spectrum, 164 F.3d at 1379-80 (internal quotations and citations omitted).

Applicant sought a narrow interpretation of reflected radiation during prosecution in order to overcome the prior art and achieve allowance. Applicant cannot now disregard its arguments made during prosecution and seek a broader interpretation of reflected radiation in order to argue for infringement. The public notice function of the prosecution process requires this Court to construe reflected radiation consistent with the interpretation applicant argued for during prosecution.

The Court is particularly persuaded by certain representations made by the applicant in his written response to the examiner's disallowance of all claims. Applicant distinguished the German patent DE '427 on the ground that its "sensor is positioned to receive direct radiation from the emitters." (Doc. 53-4, Ex. C, p. 63.) Applicant made a similar argument to distinguish the Cimino patent: "The detectors are in a direct line of sight from the bulbs, so that they receive direct radiation." (*Id.*) Owesen was distinguished on the ground that because it received a mixture of both direct and reflected radiation it could not measure reflected radiation. (*Id.*, Ex. C, pp. 64-65)

Thus, according to the applicant, the prior art lacked the critical limitation of the present invention: measuring reflected radiation. The applicant stated that "[o]perational control by measuring *reflected* radiation is novel and unique to this device" and that "[t]his feature is critical to effective disinfection of an area such as a room." (*Id.*, Ex. C, p. 61) Further, reflected radiation is radiation that is reflected from the "walls and ceiling

of the room" rather than from the device itself. (*Id.*)

IPT's proposed construction incorporates the "critical" limitation used by the applicant to distinguish his device from the prior art. The Federal Circuit has long noted that "claim language [must be] limited based on a feature that was described as essential to the invention." *See Sunrace Roots Enter. Co., Ltd. v. SRAM Corp.*, 336 F.3d 1298, 1305 (Fed.Cir.2003). Lumalier, on the other hand, now seeks a broader construction for "reflected radiation" that could include radiation directly emitted from the device. Specifically, Lumalier argues that the claims allow the device to *receive* direct radiation, even if it only *measures* reflected radiation. This argument is inconsistent with the arguments Lumalier made during prosecution to distinguish prior art; the Court is not persuaded. IPT's narrower construction is supported by the prosecution history, and the Court finds it persuasive.

3. Lumalier's Other Arguments Are Inapplicable

Lumalier makes two additional arguments in support of its proposed construction: (1) that use of the term "comprising" in the claims means the claims are open-ended and do not preclude measuring other types of radiation in addition to reflected radiation; and (2) that IPT's proposed construction ignores the doctrine of claim differentiation. The Court addresses these arguments in turn.

Lumalier says that IPT's proposed construction is inconsistent with the use of the preamble term "comprising" in the patents. The asserted claims all use the term "comprising" before listing a series of steps. Among the steps are measuring reflected radiation. *See supra* Part II.C. Lumalier cites case law for the proposition that comprising is a word of art that is "well understood in patent law to mean including but

not limited to." *Exergen Corp. v. Wal-Mart Stores, Inc.*, 575 F.3d 1312, 1319 (Fed. Cir. 2009); *Georgia-Pacific Corp. v. U.S. Gypsum Co.*, 195 F.3d 1322, 1327 (Fed. Cir. 2000) ("The transitional term 'comprising' . . . is inclusive or open-ended and does not exclude additional, unrecited elements or method steps."). From this, Lumalier argues that it is improper to exclude detection of *direct* radiation from the scope of the claims, even though detection of direct radiation is not explicitly provided. ("This added limitation is an effort to exclude subject matter, i.e. detection of direct radiation, from the scope of the 'asserted claims' in an effort to avoid infringement. However, IPT's proposed construction is inconsistent with the use of the preamble term 'comprising' in the Patents. (Lumalier's Claim Const. Br. at 9))

The Court is not convinced. While the Court acknowledges that "comprising" is often an open-ended term, the Federal Circuit has held that the term "comprising" may not alter the scope of the claim. *Spectrum*, 164 F.3d at 1372 (citing *Moleculon Research Corp. v. CBS, Inc.*, 793 F.2d 1261, 1271 (Fed. Cir. 1986)). "'Comprising' is not a weasel word with which to abrogate claim limitations." *Id.* The Court has already discussed that the claims, when read in light of the specification and prosecution history, support the limitation that "reflected radiation" not include radiation emitted directly from the device. "The claim term 'comprising' cannot restore this excluded subject matter." *Id.*

Next, Lumalier argues that IPT's proposed construction ignores claim differentiation. Certain independent claims of the '424 patent recite "receive reflected ultraviolet-C radiation" and others recite "receive only reflected ultraviolet-C radiation." Lumalier argues that the use of "only" in certain claims renders those claims narrower in

scope than the others, and evinces an intent by the drafters that certain claims be limited to receiving only reflected radiation, while other claims not be so limited.

Claim differentiation refers to the "presumption that an independent claim should not be construed as requiring a limitation added by a dependent claim." *Curtiss-Wright Flow Control Corp. v. Velan, Inc.*, 438 F.3d 1374, 1380 (Fed. Cir. 2006). As a tool for construing claims, it works best in the relationship between independent and dependent claims. *Id.* Where, as here, the Court is asked to use claim differentiation as between independent claims, the Federal Circuit has cautioned that "claim differentiation is a guide, not a rigid rule." *Id.* at 1381. This is because "claim drafters can . . . use different terms to define the exact same subject matter." *Id.* at 1380. With these principles in mind, the Federal Circuit held that two principles govern claim differentiation when applied to independent claims: "(1) claim differentiation takes on relevance in the context of a claim construction that would render additional, or different, language in another independent claim superfluous; and (2) claim differentiation can not broaden claims beyond their correct scope." *Id.* at 1381 (internal quotations and citations omitted).

Here, Lumalier seeks to improperly use claim construction to broaden the claims beyond their correct scope. As discussed in depth above, the specification and prosecution history clearly support a construction of "reflected radiation" that excludes radiation directly emitted form the device. Thus, the great weight of the intrinsic evidence does not support Lumalier's proposed construction. Moreover, because Lumalier seeks to apply claim differentiation to two independent claims rather than to an independent claim and a dependent claim, the tool is merely a guide, not a rigid rule.

The Court does not believe the addition of "only" in certain claims changes any of its analysis.

For these reasons, the Court adopts IPT's construction: "*radiation that is reflected from items in an area as opposed to radiation that is from the UV-C device directly*."

B. "measuring" / "measures"

The asserted claims 1, 3, and 6 of the '424 patent, and claims 1 and 11 of the '177 patent include the term "measuring" or "measures."

IPT says the Court should construe the term as "*determining the quantity of*." IPT says that "measure" is easily understood, and that its definition is consistent with the ordinary meaning of the term as understood by a person of skill in the art. It cites a dictionary definition: "to determine the dimensions, quantity, or capacity of." Webster's II New College Dictionary.

Lumalier says the Court should construe the term as "*generating data associated with*." It says this definition is supported by the specification of the '424 patent, particularly at column 4, lines 21-26. The passage describes the operation of the ultraviolet-C radiation sensors. It reads:

> The bulbs are powered, and when sufficient time has elapsed to allow the bulbs to reach a steady state output (one minute or less), the BASIC Stamp *reads data* from all the individual sensors located on the array. The array senses 360 degrees at a minimum with overlapping of their window of view. They are oriented away from the UVAS, thus measuring the dose of UV-C reflected back to the unit. This *data* is reflected back to the microcontroller where it is integrated to compute cumulative exposure of UV-C reflected back from each sensor in the array.
>
> ('424 patent, col. 4, ll. 19-28 (emphasis added))

Lumalier says this passage demonstrates that when a sensor "measures" reflected ultraviolet-C radiation, it is "generating data associated with" the received light. "Measure" does not require quantifying the light; it only requires "that some data, or information, associated with the received radiation be generated by the device."

The Court begins its analysis with a review of the claims. The specific language used in the claims indicates that "measures" is properly understood as "quantifies." The claims provide that at some point the device terminates emission of ultraviolet-C radiation upon determining that a bactericidal dose has been emitted. The device "measures" reflected radiation to determine when termination is appropriate, but the claims use different words to describe the conditions for termination. For example, claim 1 of the '424 patent states that termination occurs when the "required minimum" of ultraviolet-C radiation has been reflected. Claim 6 of the '424 patent says emission is terminated when the "cumulative level" of ultraviolet-C radiation has been received. Claims 1 and 11 of the '177 patent say emission is terminated when the "required . . . level" has been reflected back.

These terms – minimum, cumulative, and level – all relate to the *quantity* of something; to say that they represent *data* in the abstract is too broad a construction. The dictionary confirms. Webster's New College Dictionary II defines minimum as "the least possible *quantity* or degree" (emphasis added). Cumulative is defined as "enlarging or increasing by successive addition." Surely, for the device to know when a cumulative measurement of radiation has been received, it needs to know when sufficient quantity of radiation has been received. Lastly, level is described as "relative rank or position." This term, too, relates to quantity or position.

In its briefs and at oral argument, Lumalier argued that dictionary definitions are not helpful because one of ordinary skill in the art at the time of the invention would not understand "measures" as used in the patents to mean "quantifies." This is because Lumalier says radiation travels in waves composed of photons, and that these waves and/or photons are not capable of being "quantified" in the dictionary sense of the term. Rather, Lumalier says the sensors on the device make a series of determinations regarding the received radiation, but they do not quantify the radiation. When pressed at oral argument to explain the types of determinations the sensors make, counsel for Lumalier was not able to give a more specific answer.

The Court is not persuaded by Lumalier's arguments. Nowhere do the claims or the specification speak of "generating data," or of making a series of determinations with respect to photons or wavelengths. Rather, as explained above, the claims use terms that all relate to quantity, i.e. level, cumulative, minimum. And, while the Court recognizes that the ordinary meaning of a term is the meaning *as understood by one skilled in the art*, Lumalier provided no evidence that one skilled in the art would understand measure as used in the patents to mean something other than quantify. As explained below, the specification and prosecution history do not support Lumalier's construction. Moreover, argument of counsel is not evidence.

Therefore, the Court agrees with IPT that the language of the claims supports an ordinary meaning construction of measures as "determines the quantity of something." But, as the Federal Circuit held, the Court cannot "look at the ordinary meaning of the term . . . in a vacuum. Rather, [it] must look at the ordinary meaning in the context of the written description and the prosecution history." *Phillips*, 415 F.3d at 1313. This is

because the claims are part of a "fully integrated instrument." *Id.* at 1315. The Court now turns to the specification and prosecution history.

Nothing in the specification changes the above analysis. Although a patentee is free to act as its own lexicographer and give a specialized meaning to a term that differs from the meaning it otherwise possesses, *Id.* at 1316, the patentee did not do so here. In fact, as IPT points out, "generating data associated with" is not discussed anywhere in the specification. Nor does the passage cited by Lumalier ('424 patent, col. 4, ll 19-28), reproduced above, support its construction. Just because the BASIC Stamp reads "data" from the sensors does not mean the sensors had not already quantified the radiation received. Indeed, the specification and claims, read as a whole, require that the reflected data be quantified in order for the device to determine when to terminate emissions.

The prosecution history strongly supports IPT's proposed construction. During prosecution, the applicant explained that measuring reflected radiation, rather than radiation that is emitted directly, is "novel and unique to the device" and "critical" to the operation of the device. (Doc. 53-4, Ex. C, p. 61.) Also during prosecution, applicant distinguished the prior art of Owesen on the grounds that it received reflected radiation in addition to direct radiation, and therefore, could not *measure* reflected radiation. (*Id.*, Ex. C, pp. 64-65) Applicant stated: "A mixture of reflected and direct radiation by an individual sensor negates the ability to determine adequate exposure and decontamination in a changing environment." (*Id.*) Thus, as persuasively argued by IPT in its brief and at oral argument, if the sensor of Owesen received both reflected and direct radiation, it would necessarily *generate data* associated with the reflected

radiation, even though it can not measure it. It would not be able to *quantify* the reflected radiation, though, because of the incidental presence of direct radiation and the inability of the device to distinguish between the two.

Lumalier is bound by its arguments made during prosecution to distinguish Owesen. It cannot now argue that "measure" means to "generate data" because if it had done so during prosecution the claims would not have been allowed.

For the reasons above, the Court adopts IPT's construction: "*determining the quantity of [something]*."

C. "sterilize"

Asserted claims 1 and 3 of the '424 patent, and asserted claims 1 and 11 of the '177 patent use the phrases "a method for sterilizing an area using ultraviolet radiation" and "a device for sterilizing an area using ultraviolet radiation."

In what appears to be a drafting error, the specification introduces two descriptions of "sterilize," one of which is proposed by IPT, the other of which is proposed by Lumalier. The relevant part provides:

> The dual programming modes of the unit allow treatment as required. One mode (Sanitize) kills all known pathogens and requires a lower exposure and thus a shorter time. The other mode **(Sterilize) kills all species of bacteria** and requires greater cumulative doses and therefore more time.
>
> The Ultraviolet Area Stabilizer self monitors bactericidal levels. Reflected doses of UV-C are measured, and the device remains activated until bactericidal levels are received. This ensures that areas in relative shadow and not in direct line of sight with the unit are sterilized. Also, the unit can be set to sanitize (kill common pathogens) or **sterilize (kill all microbes).**
>
> ('424 patent, col. 5, ll. 12-25 (emphasis added))

The dispute is over which of these two definitions should be adopted. As Lumalier

points out, the two definitions are not consistent because "all microbes" encompasses more organisms than the phrase "all species of bacteria." "All microbes" may include non-bacterial microorganisms such as fungi and viruses.

IPT, relying on a dictionary definition, argues that to "sterilize" something is to free it from all microorganisms. IPT said at oral argument that it was proper to refer to extrinsic evidence to define the term where, as here, the intrinsic evidence is ambiguous or conflicting. IPT further argues that one skilled in the art is well aware of its definition of sterilize.

Lumalier says the proper construction of "sterilize" is kill all species of bacteria. Lumalier relies primarily on the specification which refers repeatedly to the device as relating to killing bacteria. Thus, Lumalier concludes, "[b]ased on the consistent usage of the term 'bactericidal' in the specifications of the Patents, one of skill in the art would understand the preamble term 'sterilizing' in the 'asserted claims' to refer to killing bacteria as opposed to killing all microbes." (Lumalier's Claim Constr. Br. at 13)

Of the two different descriptions, Lumalier's construction is more closely supported by the specification. The Court identifies the following relevant passages:

- "to obtain a *bactericidal* dose" ('424 patent, Abstract)
- UV-C light "has been shown to be the most *bactericidal* type" ('424 patent, col. 2., ll. 3-5)
- device positioned "where concern exists regarding the presence of *pathogenic bacteria*" ('424 patent, col. 2, ll. 19-21)
- "*bactericidal dose*" ('424 patent, col. 2., ll. 32, 36)
- "The *pathogenic bacteria* in the room have been effectively eliminated."

('424 patent, col. 2, ll. 40-42)

- "calculations regarding *bactericidal doses*" ('424 patent, col. 3, ll. 58-59)
- paragraph description of effectiveness at killing various types of bacteria ('424 patent, col. 4, ll. 43-67)
- "the device remains activated until *bactericidal* levels are received" ('424 patent, col. 5., ll. 20-22)

All of these passages from the specification, which consistently discuss the device as a means of killing bacteria rather than all microbes, strongly support Lumalier's construction.

IPT's dictionary definition is unpersuasive in light of the overwhelming intrinsic evidence that sterilize as used in the patents refers to killing bacteria. The specification is "the single best guide to the meaning of a disputed term." *Vitronics*, 90 F.3d at 1582. In *Phillips*, the Federal Circuit cautioned against starting with a dictionary or treatise definition rather than the intrinsic evidence. 415 F.3d at 1321 ("The risk of systematic overbreadth is greatly reduced if the court instead focuses at the outset on how the patentee used the claim term in the claims, specification, and prosecution history, rather than starting with a broad definition and whittling it down."). Here, the patentee consistently used the claim term to mean killing all species of bacteria; therefore, that description prevails over a conflicting dictionary definition.

IPT also argues the Lumalier's proposed construction merely adds ambiguity to the term because to kill all *species* of bacteria is not the same as to kill all bacteria in an area. For example, IPT says Lumalier's construction is open to the interpretation that the device might kill a small amount of each *species* of bacteria in an area, without

killing each and every bacteria. IPT says this construction is designed solely to confuse the jury.

The Court agrees that the portion of Lumalier's proposed construction that speaks of "species" merely adds ambiguity. Although Lumalier's construction is taken directly from the specification, other portions of the specification help to clarify. First, the Summary, after describing the operation of the device, states that "[t]he pathogenic bacteria in the room have been effectively eliminated." ('424 patent, col. 2, ll. 40-42) "Eliminated" refers to bacteria, not each species of bacteria. Another passage describes how direct exposure from the device reduces colony counts of bacteria "by a minimum of 99.9% in one minute and achieve[s] sterilization in 10 minutes." (*Id.*, col. 4, ll. 45-49) Again, this implies that all bacteria are killed, not all *species* of bacteria. Moreover, the claims and specification refer repeatedly to "bactericidal" doses. Webster's II New College Dictionary defines "bactericide" as an agent that destroys bacteria. The implication of the term is that all bacteria are killed, especially when the term is used in conjunction with sterilize. For these reasons, the Court does not include Lumalier's reference to "species" in its construction.

Lastly, for the sake of completeness, the Court notes that there are a couple of other passages in the specification that could support IPT's construction of killing all microbes. First, the "Field the Invention" states that the invention relates to methods and devices for "bacterial, fungal, and/or viral sterilization." ('424 patent, col. 1, ll. 13-14) Second, the "Background of the Invention" discusses how hospitals harbor "virulent strains of bacteria, fungi, and viruses," and that "anti-microbal resistance" is a big problem in hospitals. These passages suggest that the device may have been intended

to address the broader problem of microbes rather than merely bacteria. Yet, where the specification discusses the specific features and operation of the invention, there is no further mention of killing all microbes. Rather, as demonstrated above, the specification speaks only of killing bacteria.

For these reasons, the court adopts Lumalier's construction with modification. "A method for sterilizing an area using ultraviolet radiation" means "*a method for killing all bacteria in an area using ultraviolet radiation.*"

D. "calculating"

Asserted claims 1 and 11 of the '177 patent use the term "calculating an ultraviolet-C radiation reflectance level necessary to sterilize said enclosed area." The phrase is also included in claim 1 of the '424 patent, though IPT argues that claim fails for indefiniteness. *See infra* Part IV.E.

IPT says the Court should construe the phrase as "*determining by a mathematical process the level of reflected UV-C radiation required to kill all microbes in the enclosed area.*" IPT says this definition is consistent with the customary and ordinary meaning of the term. IPT cites a dictionary definition for calculating as "determining by a mathematical process." Webster's II New College Dictionary (2001) IPT also cites to the specification, which discusses how a series of microcontrollers called BASIC stamps perform calculations using algorithms to determine when a bactericidal dose has been emitted. From this, IPT argues that "if the claim language of 'calculating' was changed to 'determining,' there would be no need for the disclosed microcontrollers and algorithms."

Lumalier says the Court should construe the phrase as "*determining an amount*

of ultraviolet-C radiation necessary to kill species of bacteria in the enclosed area." Lumalier says that IPT's proposed construction adds a limitation -- by a mathematical process -- that is not recited in or supported by the intrinsic record. Further, Lumalier says that IPT does not describe what the mathematical process entails, so the phrase actually creates uncertainty.

The proposed constructions include the dispute regarding "sterilize," discussed in the previous section. The Court' construction of sterilize, *a method for killing all species of bacteria in an area using ultraviolet radiation*, will be imported into this term. Thus, the only remaining issue is the meaning of "calculating." The Court turns to that now.

The Court begins its analysis by looking at the claim language itself. As IPT points out, the claims use both terms "calculating" and "determining." For example, claim 1 of the '424 patent reads "**calculating** the ultraviolet-C radiation level . . ." as well as "**determining** that the required minimum ultraviolet-C radiation has been reflected . . ." ('424 patent, col. 5, ll. 57, 61-62) Yet, Lumalier's proposed construction defines "calculating" as "determining an amount." Substituting "determining" for "calculating" is inconsistent with the requirement that the Court give effect to each term in a claim.

Because the two words are used differently in the claims, the Court presumes that they have different meanings. The Federal Circuit explained as follows:

> It is certainly established that claims are to be construed to preserve the patent's internal coherence. In addition, in the absence of any evidence to the contrary, we must presume that the use of different terms in the claims connotes different meanings. In other words, the use of two terms in a claim requires that they connote different meanings . . . .
>
> *Applied Medical Research Corp. v. U.S. Surgical Corp.*, 448 F.3d 1324, 1333 n.3 (Fed. Cir. 2006) (internal quotations and citations omitted)

Thus, because the drafters of the claims used "calculating" to describe one step and "determining" to describe another, the Court presumes that choice to be deliberate. The two words do not have the same meaning.

The specification offers some guidance on the proper construction of "calculating." The specification explains that the device is controlled by a series of programmable microcontrollers called BASIC stamps. To determine when the device terminates emission of UV-C radiation, the BASIC stamp "adds the cumulative total of the voltage received" and shuts off the device when it reaches a "minimum cumulative total." ('424 patent, col. 3, ll. 36-37, 40) The words "adds" and "cumulative total" imply that a mathematical process must take place. Even more convincing is the fact that the stamps operate using algorithms. The specification states that the stamps can be programmed, "thus allowing alteration to the algorithms to accommodate special circumstances." (*Id.*, col. 3, ll. 63-65) Use of the word "algorithms" strongly suggests that some mathematical process takes place. Webster's II New College Dictionary defines algorithm as "a mathematical rule or procedure for solving a problem."

For these reasons, the Court is persuaded by IPT's construction of "calculating." The Court construes the term as "*determining by a mathematical process the level of reflected UV-C radiation required to kill all bacteria in the enclosed area*."

E. '424 Patent Claim 1 Indefiniteness

IPT argues that certain terms within claim 1 of the '424 patent render the claim indefinite and, therefore, invalid for failing to satisfy 35 U.S.C. § 112. The terms that IPT says render the claim indefinite are:

- "calculating the ultraviolet-C radiation level necessary to sterilize said enclosed area"
- "the measured reflected ultraviolet-C radiation"
- "the required minimum ultraviolet-C radiation"

IPT asserts that these claim terms lack an antecedent basis. Specifically, IPT argues:

> In step (b), the claim recites: "measuring a reflection of ultraviolet-C radiation from each of multiple points within said enclosed area." Later in the step (c) of the same claim, it states: "calculating the ultraviolet-C radiation level necessary to sterilize said enclosed area and comparing it with the measured reflected ultraviolet-C radiation." While "the measured reflected ultraviolet-C radiation" must refer to an earlier limitation of the claim, it is unclear what is being referenced. Specifically, it is unclear whether it refers to the reflection that is measured *at one point* **or** *a aggregate reflection at the several separate "multiple points."*
>
> (IPT's Claim Const. Br. p. 17 (emphasis in brief))

IPT also says there is no antecedent basis for "the ultraviolet-C radiation level necessary to sterilize said enclosed area" or "the required minimum ultraviolet-C radiation."

Lumalier says that the claim terms are neither unclear nor lacking in an antecedent basis. Further, the claims enjoy a presumption of validity under Federal Circuit case law.

35 U.S.C. § 112, ¶ 2 requires that a patent specification "conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention." Whether a claim is indefinite under this section is a question of law for courts to make during claim construction. *IGT v. Bally Gaming Int'l, Inc.*, 659 F.3d 1109, 1119 (Fed. Cir. 2011). A claim is definite if "one skilled in the art

would understand the bounds of the claim when read in light of the specification." *Exxon Research & Eng'g Co. v. United States*, 265 F.3d 1371, 1375 (Fed. Cir. 2001). A claim is only indefinite if it is "not amenable to construction or [is] insolubly ambiguous." *Ultimax Cement Mfg. Corp. v. CTS Cement Mfg. Corp.*, 587 F.3d 1339, 1352 (Fed. Cir. 2009).

Proof of indefiniteness is a very high standard. "Claims are not indefinite merely because they present a difficult task of claim construction." *Halliburton Energy Services, Inc. v. M-I LLC*, 514 F.3d 1244, 1249 (Fed. Cir. 2008). The standard is met only when the "an accused infringer shows by clear and convincing evidence that a skilled artisan could not discern the boundaries of the claim based on the claim language, the specification, and the prosecution history, as well as her knowledge of the relevant art." *Id.*

One circumstance in which claims have been found to be indefinite is when a term does not have a proper antecedent basis. *Energizer Holdings, Inc. v. Int'l Trade Comm'n*, 435 F.3d 1366, 1370-71 (Fed. Cir. 2006). That said, "the failure to provide explicit antecedent basis for terms does not always render a claim indefinite. If the scope of a claim would be reasonably ascertainable to those skilled in the art, then the claim is not indefinite." Manual of Patent Examining Procedure, MPEP § 2173.05(e). Here, IPT has not show by clear and convincing evidence that the claim is insolubly ambiguous; the scope of the claim is ascertainable to those skilled in the art.

For the sake of convenience, claim 1 is reproduced here in full:

1. A method of sterilizing an area using ultraviolet light, comprising the steps of:

(a) causing ultraviolet-C radiation to be emitted within an enclosed area;

(b) measuring a reflection of ultraviolet-C radiation from each of multiple points within said enclosed area;

(c) calculating the ultraviolet-C radiation level necessary to sterilize said enclosed area and comparing it with the measured reflected ultraviolet-C radiation;

(d) terminating the emission of ultraviolet-C radiation after determining that the required minimum ultraviolet-C radiation has been reflected from each of said multiple points within said enclosed area.

('424 patent, col. 5, ll. 50-63)

The Court believes that a clear antecedent basis exists for each of the disputed terms. "Measured reflected ultraviolet radiation" in step (c) refers back to the measured radiation of step (b). The disputed term "required minimum ultraviolet-C radiation" from step (d) refers back to the "calculated" ultraviolet-C radiation from step (c).

The Court rejects IPT's indefiniteness argument and construes the disputed terms in a manner consistent with its previous constructions, as follows:

- *determining by a mathematical process the level of reflected UV-C radiation required to kill all bacteria in the enclosed area*
- *the quantified radiation that is reflected from items in a room as opposed to radiation that is from a UV-C emitter directly*
- *the amount of ultraviolet-C radiation for killing all bacteria in the enclosed area*

F. "around" and "above"

Asserted claim 3 of the '424 patent contains the disputed claim term "said plurality of ultraviolet-C radiation emitters are positioned on said base to emit ultraviolet-C radiation 360 degrees around said base and above said base."

IPT says this claim should be construed as "*the UV-C emitters are positioned on*

the base to emit radiation 360 degrees horizontally around the base and vertically above the base." IPT seeks to add the term "vertically" because "if the base blocked the bulbs in the vertical direction – the UV-C emitters could not emit radiation above the base."

Lumalier's proposed construction reads: "*the at least two ultraviolet-C radiation emitters are positioned on the base to collectively emit ultraviolet-C radiation 360 degrees around the base and to collectively emit ultraviolet-C radiation above the base.*" Lumalier says its construction is consistent with the plain and ordinary meaning of the terms. Lumalier also says that IPT's proposed construction seeks to add two terms – "vertically" and "horizontally" – that are not supported by the intrinsic evidence.

The Court agrees with Lumalier. IPT's proposed addition of vertically and horizontally does not clarify the term; if anything, it adds a limitation that is not present in the intrinsic record. Here, the ordinary meaning of the disputed phrase is obvious, even to a lay person. *See Phillips*, 415 F.3d at 1314 ("In some cases, the ordinary meaning of claim language as understood by a person of skill in the art may be readily apparent even to lay judges, and claim construction in such cases involves little more than the application of widely accepted meaning of commonly understood words.").

Lumalier's proposed construction reflects the ordinary meaning; the Court adopts it.

G. "measuring a level of reflected ultraviolet-C radiation received by said at least one sensor"

Asserted claim 6 of the '424 patent provides contains the disputed phrase "measuring a level of reflected ultraviolet-C radiation received by said at least one sensor."

IPT says that these claim limitations have already been addressed *supra* in Sections IV. A-B. Importing its proposed constructions from those claim terms, IPT arrives at the its proposed construction here: "*determining the quantity of radiation that is reflected from items in a room as opposed to radiation that is from a UV-C emitter directly that is received by at least one sensor.*"

Lumalier's proposed construction similarly relies on its previous constructions for "reflected ultraviolet-C radiation" and "measuring." Lumalier proposes: "*generating data associated with ultraviolet-C radiation that has bounced off any surface and has been incident upon the at least one sensor*."

The Court previously adopted IPT's constructions for "reflected ultraviolet-C radiation" and measuring. *See supra* Parts IV. A, B. IPT's construction here merely incorporates its previous proposed constructions. As such, the Court adopts IPT's construction: "*determining the quantity of radiation that is reflected from items in a room as opposed to radiation that is from a UV-C emitter directly that is received by at least one sensor.*"

H. "measuring a reflection of ultraviolet-C radiation from the multiple positions within said enclosed area"

Asserted claim 1 of the '177 patent contains the phrase "measuring a reflection of ultraviolet-C radiation from the multiple positions within said enclosed area." The Court has already construed "measuring" and "a reflection of ultraviolet-C radiation"; those constructions will be imported here. The Court is left to construe the term "from the multiple positions within said enclosed area."

IPT says that "from the multiple positions within said enclosed area" should be

construed as "*from the same positions where ultraviolet-C radiation was emitted*."

Lumalier says the term should be construed "*from the at least two locations within said the enclosed area.*"

The Court begins its analysis with the language of the claim itself. A couple of issues are evident. The first issue is to what does "from the multiple positions within said enclosed area" refer back to, or modify? Lumalier says it modifies the location of "measuring," and not the source of the "reflection of ultraviolet-C radiation." IPT takes the opposite position.

IPT has the stronger argument. Step (a) of claim 1 states: "causing ultraviolet-C radiation to be emitted from multiple positions within an enclosed area." Step (b), the language in dispute here, states: "measuring a reflection of ultraviolet-C radiation from **the** multiple positions within said enclosed area" (emphasis added). Use of term "the" is informative: it indicates that "multiple positions" in step (b) refers back to "multiple positions" in step (a). IPT's construction reflects the proper antecedent basis for the disputed phrase.

A second issue that arises from the claim text is whether the measurement that occurs "from the multiple positions" is an aggregate measurement, or an individual measurement from each position. A comparison with the text of claim 11 of the '177 patent is instructive. The relevant part of that claim reads: "measuring a *cumulative* reflection of ultraviolet-C radiation from *each* of the multiple positions within said enclosed area" (emphasis added). The text is identical to claim one, with the added limitations "cumulative" and "each." Comparing the language of the two claims resolves the ambiguity over whether the measurement is aggregate or individualize: use of the

terms “each” and “cumulative” in claim 11 demonstrates that the measurement is from each individual sensor; lack of those terms in claim 1 indicates that the measurement is an aggregate of the multiple sensors.

For these reasons, the Court construes “measuring a reflection of ultraviolet-C radiation from the multiple positions within said enclosed area” as “*determining the quantity of radiation that is reflected from items in a room as opposed to radiation that is from a UV-C emitter directly from the same positions where ultraviolet-C radiation was emitted*.”

I. “measuring a cumulative reflection of ultraviolet-C radiation from each of the multiple positions within said enclosed area”

Asserted claim 11 of the ‘177 patent contains the disputed phrase “measuring a cumulative reflection of ultraviolet-C radiation from each of the multiple positions within said enclosed area.”

The Court discussed this phrase in the previous section in conjunction with claim 1 of the ‘177 patent. For the reasons stated in that section, the Court construes the phrase as follows: “*determining the quantity of radiation that is reflected from items in a room as opposed to radiation that is from a UV-C emitter directly from each of the same positions where ultraviolet-C radiation was emitted*.”

J. ‘177 Patent Claims 1 and 11 Indefiniteness

IPT says claims 1 and 11 of the ‘177 are void for indefiniteness because certain claim terms lack an antecedent basis. Step (d) of claim 1 states: “terminating the emission of ultraviolet-C radiation after determining that the required ultraviolet-C radiation reflectance level has been reflected from the multiple positions within said

enclosed area." Step (d) of claim 11 is identical, with the addition of "each," so that the relevant part reads "from each of the multiple positions." IPT says that "the required ultraviolet-C radiation reflectance level" lacks an antecedent basis.

Lumalier says that the disputed termination step, quoted in the previous paragraph, relates back to the "comparing" step (c) of the claim. Specifically, Lumalier says the claim requires the "comparing" step to continue until the "required ultraviolet-C radiation reflectance level has been reflected." Then, the terminating step (d) causes the emission of ultraviolet-C radiation to end.

The Court cannot say that claims 1 and 11 of the '177 patent are insolubly ambiguous. IPT's indefiniteness argument is rejected.

The Court construes claim 1 as: "*terminating the emission of ultraviolet-C radiation after determining that the required ultraviolet-C radiation has been reflected from the same positions where ultraviolet-C radiation was emitted*."

The Court construes claim 11 as: "*terminating the emission of ultraviolet-C radiation after determining that the required ultraviolet-C radiation has been reflected from each of the same positions where ultraviolet-C radiation was emitted*."

V. CONCLUSION

These are the constructions of the Court.

IT IS ORDERED.

S/Victoria A. Roberts
Victoria A. Roberts
United States District Judge

Dated: August 8, 2012

The undersigned certifies that a copy of this document was served on the attorneys of record by electronic means or U.S. Mail on August 8, 2012.

S/Linda Vertriest
Deputy Clerk

Case Name: Infection Prevention Technologies, LLC v Lumalier Corporation
Case Number: 10-12371

APPENDIX A: Claim Construction Chart

Claim Term	IPT's Proposed Construction	Lumalier's Proposed Construction	Court's Construction
"a reflection of ultraviolet-C radiation" "reflected ultraviolet-C radiation"	"radiation that is reflected from items in an area as opposed to radiation that is from the UV-C device directly"	"any ultraviolet-C radiation that bounces off any surface"	"radiation that is reflected from items in an area as opposed to radiation that is from the UV-C device directly"
"measuring" "measures"	"determining the quantity of [something]"	"generating data associated with"	"determining the quantity of [something]"
"a method for sterilizing an area using ultraviolet radiation" "a device for sterilizing an area using ultraviolet radiation"	"a method/device for killing all microbes in an area using ultraviolet radiation"	"a method for killing all specifies of bacteria in an area using ultraviolet radiation"	"a method for killing all bacteria in an area using ultraviolet radiation"
"calculating an ultraviolet-C reflectance level necessary to sterilize said enclosed area"	"determining by a mathematical process the level of reflected UV-C radiation required to kill all microbes in the enclosed area"	"determining an amount of ultraviolet-C radiation necessary to kill all species of bacteria in the enclosed area"	"determining by a mathematical process the level of reflected UV-C radiation required to kill all bacteria in the enclosed area"

Case Name: Infection Prevention Technologies, LLC v Lumalier Corporation
Case Number: 10-12371

Claim Term	IPT's Proposed Construction	Lumalier's Proposed Construction	Court's Construction
"calculating the ultraviolet-C radiation level necessary to sterilize said enclosed area" "the measured reflected ultraviolet-C radiation" "the required minimum ultraviolet-C radiation"	Indefinite	"determining a bactericidal dose of ultraviolet-C radiation for the enclosed area" "data associated with ultraviolet-C radiation that has bounced off at least one surface within the enclosed area" "the amount of ultraviolet-C radiation for sterilizing the enclosed area"	"determining by a mathematical process the level of reflected UV-C radiation required to kill all bacteria in the enclosed area" "the quantified radiation that is reflected from items in a room as opposed to radiation that is from a UV-C emitter directly" "the amount of ultraviolet-C radiation for killing all bacteria in the enclosed area"
"said plurality of ultraviolet-C radiation emitters are positioned on said base to emit ultraviolet-C radiation 360 degrees around said base and above said base"	"the UV-C emitters are positioned on the base to emit radiation 360 degrees horizontally around the base and vertically above the base"	"the at least two ultraviolet-C radiation emitters are positioned on the base to collectively emit ultraviolet-C radiation 360 degrees around the base and to collectively emit ultraviolet-C radiation above the base"	"the at least two ultraviolet-C radiation emitters are positioned on the base to collectively emit ultraviolet-C radiation 360 degrees around the base and to collectively emit ultraviolet-C radiation above the base"
"measuring a level of reflected ultraviolet-C radiation received by said at least one sensor"	"determining the quantity of radiation that is reflected from items in a room as opposed to radiation that is from a UV-C emitter directly that is received by the at least one sensor"	"generating data associated with ultraviolet-C radiation that has bounced off any surface and has been incident upon the at least one sensor"	"determining the quantity of radiation that is reflected from items in a room as opposed to radiation that is from a UV-C emitter directly that is received by the at least one sensor"

Case Name: Infection Prevention Technologies, LLC v Lumalier Corporation
Case Number: 10-12371

Claim Term	IPT's Proposed Construction	Lumalier's Proposed Construction	Court's Construction
"measuring a reflection of ultraviolet-C radiation from the multiple positions within said enclosed area"	"measuring a reflection of ultraviolet-C radiation from the same positions where ultraviolet-C radiation was emitted"	"generating, from the at least two locations within the enclosed area, data associated with any ultraviolet radiation that has bounced off any surface"	"determining the quantity of radiation that is reflected from items in a room as opposed to radiation that is from a UV-C emitter directly from the same positions where ultraviolet-C radiation was emitted"
"measuring a cumulative reflection of ultraviolet-C radiation from each of the multiple positions within said enclosed area"	"measuring a cumulative reflection of ultraviolet-C radiation from the same positions where ultraviolet-C radiation was emitted"	"generating, from each of the at least two locations within the enclosed area, data associated with ultraviolet-C radiation that has bounced off any surface over time"	"determining the quantity of radiation that is reflected from items in a room as opposed to radiation that is from a UV-C emitter directly from each of the same positions where ultraviolet-C radiation was emitted"
"terminating the emission of ultraviolet-C radiation after determining that the required ultraviolet-C radiation reflectance level has been reflected from the multiple positions within said enclosed area"	Indefinite	"terminating, from the at least two locations in the enclosed area, the emission of ultraviolet-C radiation after determining that the required amount of ultraviolet-C radiation has been reflected:	claim 1: "terminating the emission of ultraviolet-C radiation after determining that the required ultraviolet-C radiation has been reflected from the same positions where ultraviolet-C radiation was emitted." claim 11: "terminating the emission of ultraviolet-C radiation after determining that the required ultraviolet-C radiation has been reflected from each of the same positions where ultraviolet-C radiation was emitted."

UNITED STATES DISTRICT COURT
EASTERN DISTRICT OF MICHIGAN
SOUTHERN DIVISION

Infection Prevention Technologies, LLC,

Plaintiff,

v

Case No: 10-12371
Honorable Victoria A. Roberts

Lumalier Corporation,

Defendant.
_____/

ORDER GRANTING PLAINTIFF'S MOTION FOR SUMMARY JUDGMENT OF NON-INFRINGEMENT (DOC. #78)

I. INTRODUCTION

Infection Prevention Technologies, LLC ("IPT") seeks a court declaration that its ultraviolet sterilization device does not infringe on Lumalier Corporation's patented ultraviolet sterilization device. The devices at issue sterilize rooms using radiation. Lumalier's patented device does this by measuring reflected radiation-- radiation that is reflected from items in an area. IPT's device measures a combination of reflected and direct radiation --radiation emitted from the device.

Six claims remain against Lumalier:

I. Declaratory judgment of non-infringement on 6,656,424 ("'424 patent") (Count One);

II. Declaratory judgment of non-infringement on 6,911,177 ("'177 patent") (Count Two);

III. Declaratory judgment of non-infringement on 7,175, 806 patent (Count Three) (dismissed without prejudiced earlier because UVAS is a

necessary and indispensable party; and the Court does not have personal jurisdiction over UVAS);

IV. Tortious interference with business relations: claim unrelated to patent infringement assertions (Count Four);

V. Injurious falsehood, defamation and slander: claim unrelated to patent infringement assertions (Count Five);

VI. False advertising under 15 U.S.C. 1125 (Count Six) (dismissed with prejudice earlier for failure to state a claim against Lumalier);

VII. Tortious interference with business relations: claim related to patent infringement assertions (Count Seven); and

VIII. Injurious falsehood, defamation and slander: claim related to patent infringement assertions (Count Eight).

The patents at issue are owned by Lumalier. After Counts Three and Six were dismissed, Lumalier filed a two Count counterclaim alleging that IPT directly and indirectly infringed on its '424 and '177 patents (the "patents"). Lumalier alleges that IPT's device infringes on claims one through nine, thirteen, and fourteen of the '424 patent; and, one through three of the '177 patent. Patent '177 is a continuation of patent '424; both patents include the same disclosures.

IPT moves for summary judgment; IPT says there is no patent infringement because its device measures both reflected radiation and direct radiation, and does not measure reflected radiation separately.

IPT's motion is **GRANTED**. There is no infringement of patents '424 and '177. IPT's device is not engineered to solely measure reflected radiation, as the Lumalier

device does.

Lumalier's counterclaims are **DISMISSED**.

Trial will proceed on Counts Four, Five, Seven, and Eight of IPT's amended complaint.

II. BACKGROUND

a. Description of the Device and the Alleged Infringing Device

The specifications in the patents say that when Lumalier's device is first powered on and safe to operate, it emits ultraviolet rays -- radiation from mercury bulbs -- which kill bacteria. These radiation rays hit objects in the room and reflect back to the eight sensors on the device. The device powers off when a room is sterile.

The device knows how much radiation to emit based on its measurement of reflected radiation from items in a room.

The sensors transmit this information to the BASIC Stamps, which is the device's program. The program determines the duration that the device should emit radiation and the minimum cumulative voltage necessary to kill bacteria in the room. This determination is called the bactericidal dose.

The device emits the radiation necessary to kill the bacteria. The sensors continuously receive reflected radiation from the room, convert the reflected radiation to a voltage reading, and transmit the voltages to the device's program.

When the program determines that the amount of radiation received by each sensor reaches the pre-determined cumulative minimum to kill the bacteria -- bactericidal dose -- it turns the device off.

IPT developed its own device which does essentially the same thing: sterilizes

rooms using radiation. It employs the same technique described above, except IPT's device measures both direct and reflected radiation to determine the amount of radiation necessary to sterilize a room.

b. What is Not in Dispute

This is undisputed: (1) Lumalier's device, which is covered by the patents, is engineered to only measure radiation that is reflected from objects in a room; not radiation emitted from the device; (2) the patents were issued specifically because of the device's ability to measure only reflected radiation to sterilize a room; (3) Lumalier owns an exclusive license to the patents, making it the only company which makes and distributes the device; and (4) IPT's device cannot differentiate between reflected and direct radiation and is engineered to measure both.

III. STANDARD OF REVIEW

The Court will grant summary judgment "if the movant shows that there is no genuine dispute as to any material fact and the movant is entitled to judgment as a matter of law." Fed. R. Civ. P. 56(a); *Anderson v. Liberty Lobby, Inc.*, 477 U.S. 242, 250-57 (1986). On a motion for summary judgment, the facts must be viewed in the light most favorable to the non-moving party. *Matsushita Elec. Indus. Co., Ltd. v. Zenith Radio Corp.*, 475 U.S. 574, 587 (1986).

A fact is material for purposes of summary judgment if proof of that fact would have the effect of establishing or refuting an essential element of the cause of action or a defense advanced by the parties. *Kendall v. Hoover Co.*, 751 F.2d 171, 174 (6th Cir. 1984).

IV. ANALYSIS

An analysis of patent infringement involves two steps. First, a claim is construed without regard to the accused product -- claim construction. Claim construction determines "the meaning and scope of the patent claims asserted to be infringed." *Markman v. Westview, Inc*., 52 F.3d 967, 976 (Fed. Cir. 1995). Second, the claim is compared to the accused product to determine whether all of the limitations of the claim are present either exactly or equivalently. *Id.* Infringement may be found only if "every limitation set forth in a claim [is] found in an accused product or process exactly or by a substantial equivalent." *Johnston v. IVAC Corp*., 885 F.2d 1574, 1577, 12 U.S.P.Q.2d (BNA) 1382, 1384 (Fed. Cir. 1989) (citations omitted).

The Court conducted a *Markman* hearing and issued its Order on August 8, 2012, defining numerous terms which the parties said were pertinent to the litigation.

Now, the Court compares the patent claims to IPT's device to determine whether it infringes. Despite the many terms that were argued at the *Markman* hearing and defined in the Court's Order, the parties' summary judgment dispute turns on the meaning of one term: "reflected radiation."

All alleged infringed claims include -- directly or by reference -- the term "reflected radiation," or an equivalent of the term.

All alleged infringed claims say reflected radiation is "measured," except claim fourteen of the '424 patent which uses "receive" instead of "measure." It says "at least one ultraviolet-C radiation sensor that is positioned relative to said at least one ultraviolet-C emitter to receive only reflected ultraviolet-C radiation."

1. Literal Infringement

IPT's device would literally infringe if it includes every claim limitation that is

included in the asserted claims. *Zelinski v. Brunswick Corp.*, 185 F.3d 1311, 1316 (Fed. Cir. 1999) (stating that "an infringement analysis requires that the patentee prove that the accused device embodies every limitation in the claim, either literally, or by a substantial equivalent"). If "one claim limitation is missing or not met, there is no literal infringement." *MicroStrategy Inc. v. Bus. Objects, S.A.,* 429 F.3d 1344, 1352 (Fed. Cir. 2005)(citing *Mas-Hamilton Group v. LaGard, Inc.*, 156 F.3d 1206, 1211 (Fed. Cir. 1998)).

IPT says there is no literal infringement for these reasons: (1) the alleged infringed claims require that the device use only reflected radiation -- whether measured or received -- to determine the dose of radiation necessary to sterilize a room; and (2) IPT's device receives and measures direct and reflected radiation, and cannot distinguish between the two.

Even the testimony of Lumalier's expert, Dr. Peters, is that both reflected radiation and direct radiation are received by IPT's device. And, Dr. Peters testifies that IPT's device cannot determine the difference between the two:

> Q. My question for you is – sir, is, how does the IPT device determine the quantity of light that's reflected off of the items in the room versus light [sic] that [sic] from the lamp to the sensor assembly itself?
> A. It can't tell the difference.

Lumalier does not dispute that a device which measures both reflected and direct radiation, and which cannot distinguish between the two, does not infringe. And, Lumalier does not dispute that IPT's device cannot measure reflected radiation separate from direct radiation. Rather -- and despite Dr. Peters' testimony -- Lumalier disputes that IPT's device measures direct radiation. Lumalier says IPT's device only receives and measures reflected radiation. Lumalier says: (1) the emitted radiation received and

measured by the device is reflected radiation, not direct radiation; and (2) even if the emitted radiation is direct radiation, "the device can operate in a manner in which a baseline radiation level is always established, meaning that the device is always measuring reflected radiation." Alternatively, Lumalier says that if the batteries die in IPT's device, it only measures reflected radiation and not direct radiation, and thus infringes.

a. IPT's Device Receives and Measures Reflected and Direct Radiation

i. Radiation Transmitted to the Sensor is Direct and Not Reflected Radiation

Lumalier says the emitted radiation, which is received and measured by IPT's device is not direct radiation because the radiation makes contact with other parts of the device before being transmitted to the sensor. Lumalier says that radiation transmitted to the sensor in this fashion is reflected radiation; and thus, IPT's device only receives and measures reflected radiation. It says a jury should decide whether this radiation is reflected radiation.

Lumalier's argument is unavailing since IPT's device is engineered such that all radiation -- direct and reflected -- must make contact with other parts of the device before being transmitted to the sensor. Further, what is reflected radiation has been construed by the Court.

Radiation ***transmitted*** from one part of the device to another part, is not reflected radiation. At claim construction, the Court said reflected radiation is "radiation that is reflected from items in an area as opposed to radiation from the UV-C device directly." *Infection Prevention Techs., LLC v. Lumalier Corp.*, No. 10-12371, 2012 U.S. Dist.

LEXIS 111231,*59 (E.D. Mich. Aug. 8, 2012). The Court also found that "the specification explicitly disavows any construction of reflected radiation that would include radiation directly emitted from the device." *Id.* at *23. The critical distinction between direct and reflected radiation is whether radiation has made impact with other items in the room; and, whether the device measures reflected radiation apart from direct radiation to calculate the bactericidal dose. Lumalier appreciated this distinction during patent prosecution:

> Sensors that measure reflected radiation, rather than measuring UV-C radiation that is emitted directly from the emitters, control the operation of the device. Operational control by measuring reflected radiation is novel and unique to the device. This feature is critical to effective disinfection of an area such as a room.

(Response to Official Action Dated April 8, 2003, p. 61).

There is no fact dispute: the radiation emitted from IPT's device does not make impact with items in the room, but is used in conjunction with reflected radiation to determine the bactericidal dose. When asked specifically whether the IPT device quantifies reflected radiation apart from direct radiation, Dr. Peters says:

> Q. What I asked you is, does [the IPT device] determine the quantity of the reflected light? Is the answer yes or no?
>
> A. It doesn't de- -- it doesn't determine the quality – the quantity of reflected light apart from the light that's impinging on the Teflon cap directly from the emitter at any given point in time.

Radiation emitted from IPT's device is not reflected radiation merely because the radiation touches -- or is transmitted through the device -- before being received and measured.

Lumalier's patents require that the sensors receive only reflected radiation and measure separately reflected radiation, that is radiation reflected from items in an area.

IPT's device receives and measures both direct and reflected radiation without distinction. Lumalier's unavailing argument does not create an issue of fact.

ii. IPT's Device Does Not Measure Reflected Radiation Separately from Direct Radiation

Lumalier says that even if IPT's device measures direct radiation, it still infringes, because over time the device can determine the amount of reflected radiation apart from direct. Lumalier also says that it can calculate the amount of reflected radiation that is emitted from and measured by the device.

Dr. Peters says:

> Q: So you'll agree with me, then, that the sensor cannot determine the quantity of the amount that's reflected off of items in the room?
>
> A: You know, yes and no. If -- if I were to take this device and put it in lots of different rooms and maybe not in a room and -- then I would be about to figure out what the -- kind of the baseline radiation was. That's always going to be the same. No matter where you put it, you're going to get the baseline radiation from the lamps.

As an initial matter, Dr. Peters' ability to ascertain the amount of reflected radiation has no bearing on the functionality of IPT's device or this litigation; pertinent to this analysis is only the device's ability. IPT's device receives and measures, but cannot determine the quantity of direct radiation apart from reflected radiation.

Even if the device could ascertain the amount of reflected radiation that is transmitted to it, no evidence shows that the device only measures reflected radiation in calculating its bactericidal dose. As the applicant explained during patent prosecution, in its specifications, and claims, the critical feature in the patent is the device's ability to measure reflected radiation to sterilize a room.

The Court holds that IPT's device does not solely receive or measure reflected

radiation, and there is no genuine dispute concerning this. There is no infringement here.

b. IPT's Device is Not Capable of Receiving and Measuring Only Reflected Radiation

Lumalier hypothesizes that if the batteries on IPT's device die, the device would receive no direct radiation, and would only measure reflected radiation. It says because IPT's device has the capacity to infringe, summary judgment is not warranted.

IPT does not dispute the feasibility of infringement; rather, IPT says Lumalier's scenario is too attenuated to constitute literal infringement. IPT says that its device is not engineered to operate in an infringing manner; there are no reports of its device functioning in an infringing manner. And, IPT says its warning label instructs users not to operate the device unless the batteries are charged. The Court agrees with IPT.

In *Ball Aerosol & Specialty Container, Inc. v. Ltd. Brands, Inc*., the Federal Circuit said literal infringement cannot rest on a possibility even though the product was reasonably capable of being put into a claimed configuration, absent specific instances of infringement. *Ball Aerosol & Specialty Container, Inc. v. Ltd. Brands, Inc*., 555 F.3d 984 (Fed. Cir. 2009).

Through Dr. Peters' testimony, Lumalier concedes that no evidence shows that IPT's device has ever functioned in an infringing manner:

> Q. [I]f the battery lamps are off, the – each battery lamp is surrounded by two Acpowered lamps, right?
>
> A. Yes.
>
> Q. So there would have to be an unusual situation where both the battery was off and for some reason the lamps to the left and the right of them did not turn on; is that fair?

A. That's correct, yes.

Q. And you have never seen one of those unusual situations occur in the field?

A. I've never seen any situation occur in the field.

Q. You've seen no evidence that indicates that such a situation has ever occurred in the
field?

A. I have not.

Lumalier's hypothetical does not create a genuine dispute. Nothing in the record supports that IPT's device literally infringes.

2. Infringement by Equivalents

"In applying the doctrine of equivalents, it is often enough to assess whether the claimed and accused products or processes included substantially the same function, way, and result." *Insituform Techs., Inc. v. Cat Contracting, Inc*., 161 F.3d 688, 692 (Fed. Cir. 1998).

Lumalier says infringement may be made out under the doctrine of equivalents because IPT's device measures over 99% of reflected radiation. It says Dr. Peters' expert report establishes that over 99% of the radiation measured by IPT's device, is reflected radiation, making less than 1% direct radiation. Lumalier says Dr. Peters' expert opinion creates a genuine fact dispute.

Lumalier cannot establish infringement by the doctrine of equivalents because its device was patented specifically because it measured 100% reflected radiation. Alternatively, IPT says Dr. Peters' finding is not credible. IPT says that on December 21, 2012, Dr. Peters filed an expert report saying that 99% of radiation is reflected. But, on November 9, 2012 and January 3, 2013, Dr. Peters recanted his finding, saying that

it was not true and his finding was not possible. IPT says 40% of the radiation is direct.

The Court need not decide whether Dr. Peters' testimony creates an issue of fact because the doctrine of equivalents is inapplicable.

While infringement may be made out under the doctrine of equivalents if the limitation or limitations not literally present are there by equivalents, *Becton Dickinson & Co. v. C.R. Bard, Inc*., 922 F.2d 792, 795-96, 17 U.S.P.Q.2d (BNA) 1097 (Fed. Cir. 1990), a patentee cannot later invoke the doctrine of equivalents to "embrace a structure that was specifically excluded from the claims, after having "specifically identified, criticized, and disclaimed . . . a configuration. *SciMed Life Sys. v. Advanced Cardiovascular Sys*., 242 F.3d 1337 (Fed. Cir. 2001)("Having specifically identified, criticized, and disclaimed the dual lumen configuration, the patentee cannot now invoke the doctrine of equivalents to "embrace a structure that was specifically excluded from the claims.").

During patent prosecution, Lumalier specified that reflected radiation means measuring and receiving no direct radiation. The patent examiner initially rejected all claims of '424 patent, saying sterilizing a room using reflected UV radiation was not novel. The applicant responded, saying that unlike prior art, its invention was novel because it only measured reflected and not direct radiation when determining the radiation necessary to sterilize a room. The applicant further distinguished its device from other science on the ground that each of its sensors only receive reflected radiation -- no direct radiation. The applicant also said that a device that receives both reflected and direct radiation is not novel unless it can differentiate between the two kinds of radiation when determining the bactericidal dose. The patent examiner found

the ‘424 patent allowable as amended.

The patent specifications also disclaim measuring any direct radiation. The patents specifications say, “By relying on reflected doses rather than direct exposure, the UVAS is able to sterilize or sanitize all surfaces within the rooms that are within view of an exposed wall or ceiling.” The patent holder intended reflected radiation to mean no direct radiation. Lumalier is now precluded from arguing that a device that cannot measure reflected radiation independent of direct radiation, infringes.

There is no infringement under the doctrine of equivalents.

IV. CONCLUSION

IPT’s motion is **GRANTED**. Summary judgment is entered in favor of IPT on Counts One and Two; there is no infringement of patents ‘424 and ‘177. IPT’s device is not engineered to solely measure reflected radiation.

Lumalier’s counterclaims are **DISMISSED**.

Trial will proceed on:

I. Tortious interference with business relations: claim unrelated to patent infringement assertions (Count Four);

II. Injurious falsehood, defamation and slander: claim unrelated to patent infringement assertions (Count Five);

III. Tortious interference with business relations: claim related to patent infringement assertions (Count Seven); and

IV. Injurious falsehood, defamation and slander: claim related to patent infringement assertions (Count Eight).

IT IS ORDERED.

S/Victoria A. Roberts
Victoria A. Roberts
United States District Judge

Dated: May 9, 2013

The undersigned certifies that a copy of this document was served on the attorneys of record by electronic means or U.S. Mail on May 9, 2013.

S/Linda Vertriest
Deputy Clerk

US006656424B1

(12) **United States Patent**
Deal

(10) **Patent No.: US 6,656,424 B1**
(45) **Date of Patent: Dec. 2, 2003**

(54) **ULTRAVIOLET AREA STERILIZER AND METHOD OF AREA STERILIZATION USING ULTRAVIOLET RADIATION**

(75) Inventor: **Jeffery L Deal**, Charleston, SC (US)

(73) Assignee: **UVAS, LLC**, Charleston, SC (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 503 days.

(21) Appl. No.: **09/665,151**

(22) Filed: **Sep. 19, 2000**

Related U.S. Application Data

(60) Provisional application No. 60/228,823, filed on Aug. 28, 2000, provisional application No. 60/190,601, filed on Mar. 20, 2000, and provisional application No. 60/183,662, filed on Feb. 18, 2000.

(51) **Int. Cl.**[7] **A61L 2/10**

(52) **U.S. Cl.** **422/3**; 422/24; 422/121; 250/455.11

(58) **Field of Search** 422/24, 121, 3, 422/62; 250/455.11

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Primary Examiner—Elizabeth McKane
(74) *Attorney, Agent, or Firm*—B. Craig Killough

(57) **ABSTRACT**

An ultraviolet area sterilizer (UVAS) is mobile or stationary. The UVAS is positioned in a room, such an operating room or intensive care unit. Motion detectors sense movement, to assure that personnel have evacuated the space to be sterilized. Subsequently, UV-C generators, such as a bank of mercury bulbs, generate intense levels of UV-C. An array of multiple UV-C sensors scan the room, and determine the darkest area, or the area reflecting the lowest level of UV-C back to the sensors. A BASIC Stamp contained in the device calculates the time required to obtain a bactericidal dose of UV-C reflected back from darkest area. Once a bactericidal dose has been reflected to all the sensors, the unit notifies the operator and shuts down. By relying on reflected doses rather than direct exposure, the UVAS is able to sterilize or sanitize all surfaces within the room that are within view of an exposed wall or ceiling.

20 Claims, 3 Drawing Sheets

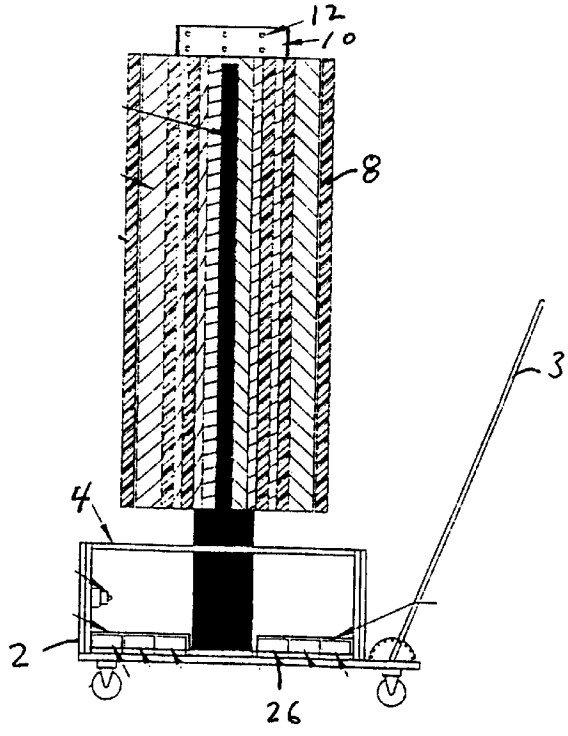


Fig 1

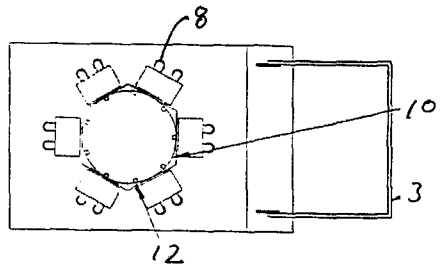
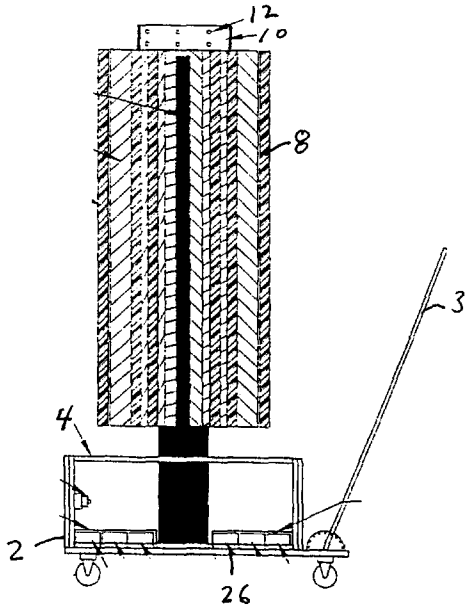


Fig 2



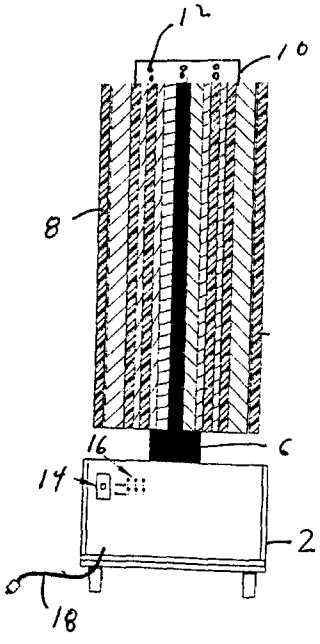


Fig 3

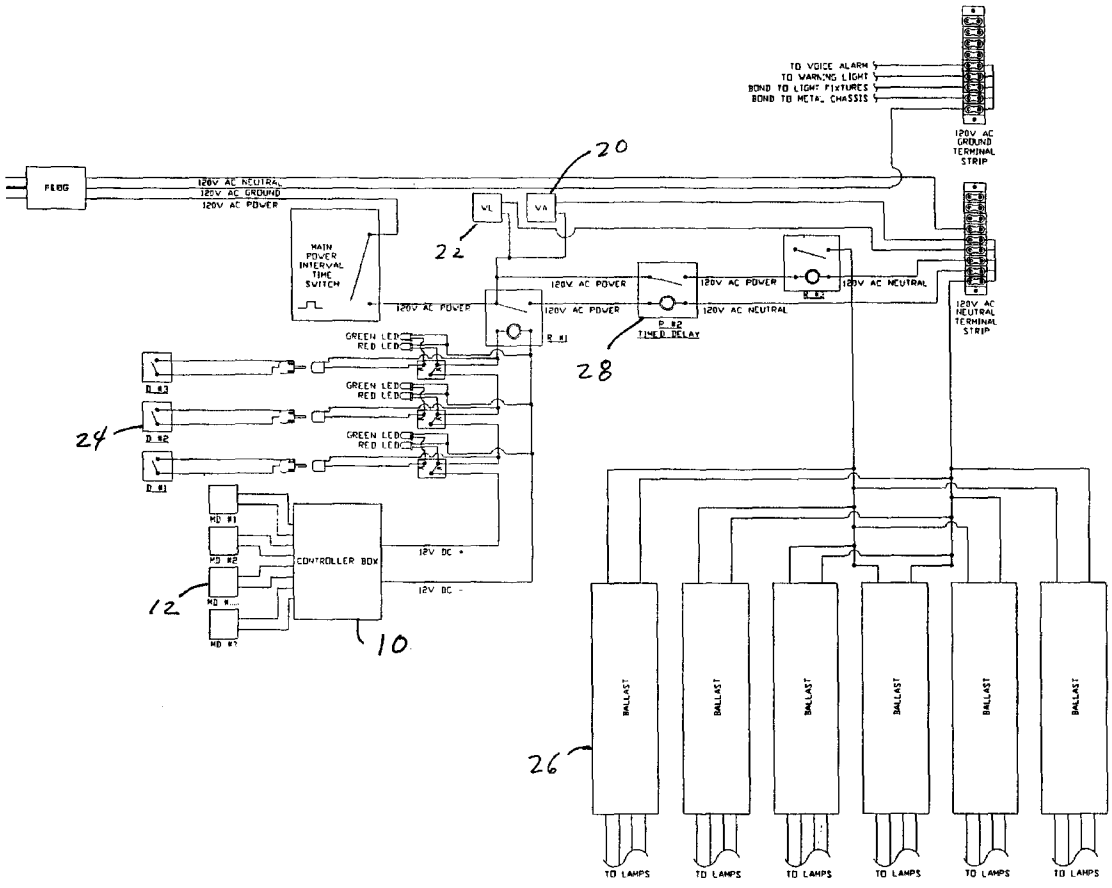

PLUG
120V AC NEUTRAL
120V AC GROUND
120V AC POWER
MAIN POWER INTERVAL TIME SWITCH
VL
VA
20
22
TO VOICE ALARM
TO WARNING LIGHT
BOND TO LIGHT FIXTURES
BOND TO METAL CHASSIS
120V AC GROUND TERMINAL STRIP
120V AC NEUTRAL TERMINAL STRIP
TIMER DELAY
28
GREEN LED
RED LED
24
CONTROLLER BOX
12V DC +
12V DC -
12
10
BALLAST
26
TO LAMPS

Fig 4

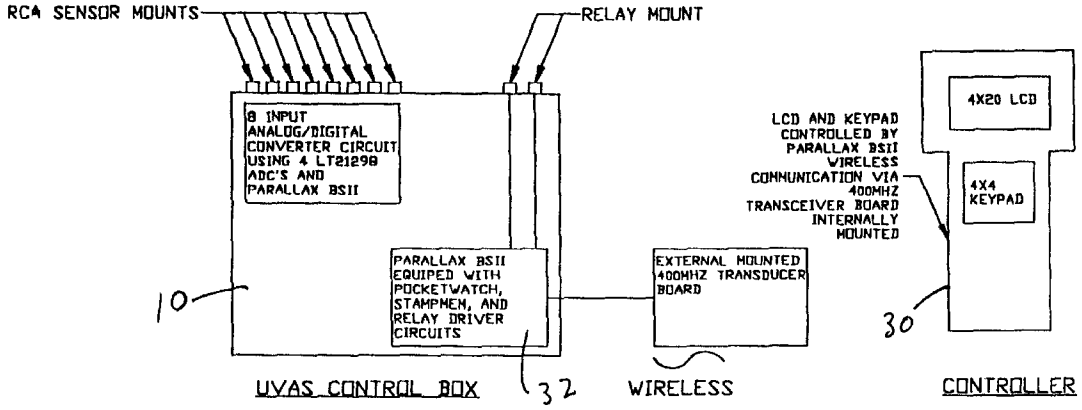

RCA SENSOR MOUNTS
RELAY MOUNT
8 INPUT ANALOG/DIGITAL CONVERTER CIRCUIT USING 4 LT21298 ADC'S AND PARALLAX BSII
PARALLAX BSII EQUIPED WITH POCKETWATCH, STAMPMEN, AND RELAY DRIVER CIRCUITS
EXTERNAL MOUNTED 400MHZ TRANSDUCER BOARD
LCD AND KEYPAD CONTROLLED BY PARALLAX BSII WIRELESS COMMUNICATION VIA 400MHZ TRANSCEIVER BOARD INTERNALLY MOUNTED
4X20 LCD
4X4 KEYPAD
10
32
30
UVAS CONTROL BOX
WIRELESS
CONTROLLER

Fig 5

ULTRAVIOLET AREA STERILIZER AND METHOD OF AREA STERILIZATION USING ULTRAVIOLET RADIATION

This invention claims priority of provisional application serial No. 60/183,662, filed Feb. 18, 2000; and provisional application serial No. 60/190,601, filed Mar. 20, 2000; and provisional application serial No. 60/228,823, filed Aug. 28, 2000.

FIELD THE INVENTION

This invention relates to methods and devices for bacterial, fungal and/or viral sterilization, and is more particularly directed to a method and device for sterilizing rooms and similar enclosed areas.

BACKGROUND OF THE INVENTION

Nosocomial, or hospital acquired, infections are common, costly, and sometimes lethal. A recent review of such infections in the cardiac surgery unit of a major hospital revealed a nosocomial infection rate of 27.3% that more than doubled the mortality rate for afflicted patients. The nature of bacteria acquired in the hospital setting differs significantly from bacteria found in a community setting primarily in their resistance to antibiotic therapy.

"Historically, staphylococci, pseudomonads, and *Escherichia coli* have been the nosocomial infection troika; nosocomial pneumonia, surgical wound infections, and vascular access-related bacteremia have caused the most illness and death in hospitalized patients; and intensive care units have been the epicenters of antibiotic resistance. Acquired antimicrobial resistance is the major problem, and vancomycin-resistant *Staphylococcus aureus* is the pathogen of greatest concern. The shift to outpatient care is leaving the most vulnerable patients in hospitals. Aging of our population and increasingly aggressive medical and surgical interventions, including implanted foreign bodies, organ transplantations, and xenotransplantation, create a cohort of particularly susceptible persons. Renovation of aging hospitals increases risk of airborne fungal and other infections.[1]"

[1] Nosocomial infection update. Weinstein R. A. Cook County Hospital, Division of Infectious Diseases, Chicago, Ill. 60612 Emerg. Infect. Dis. 1998 July–September;4(3):416–20

Significant morbidity, mortality, and costs are associated with these infections. Many factors contribute to these dangerous infections. Most notably are the overuse of antibiotics and poor personal hygiene such as hand washing. Abundant evidence exists, however, that the hospital environment itself contributes to the problem by harboring virulent strains of bacteria, fungi, and viruses, and that many methods commonly used are ineffective and may actually spread contaminants.

Attempts to eradicate surface contaminates from the hospital setting have varied greatly in strategy and success. These have ranged from antiseptic soaps to fumigation with formaldehyde gas. Topical antiseptics are problematic for several reasons. First, they have recently been shown to actually induce antibiotic resistances and thus may be adding to the problem. Secondly, many surfaces such as keyboards, television sets, and monitoring controls are difficult if not impossible to decontaminate with liquid disinfectants without harming the electronics. Gas disinfection, while effective, is time consuming, hazardous to workers, and environmentally unwise.

Ultraviolet (UV) light has been long used for disinfection and sterilization. Ultraviolet light may be produced artificially by electric-arc lamps. Recently, the widespread availability of low to medium pressure mercury bulbs has led to the development of devices which use UV-C to decontaminate water supplies. UV-C is a high frequency wavelength of light within the ultraviolet band and has been shown to be the most bactericidal type of ultraviolet light. UV-C has wavelengths of about 2800 Å to 150 Å. To date, there are no published efforts to use UV-C to decontaminate or disinfect larger areas such as operating rooms. The only recent availability of the appropriate bulbs as well as significant safety concerns regarding worker exposure to UV-C likely contribute to the lack of efforts to use UV-C outside of self-contained water purification systems.

SUMMARY OF THE INVENTION

The ultraviolet area sterilizer of the present invention (UVAS) is an automated room sterilizer. The unit may be mobile or stationary, with the unit incorporated into the room design. The UVAS is positioned in a room, such an operating room or intensive care unit, where concern exists regarding the presence of pathogenic bacteria on environmental surfaces. A wireless remote control may be used to activate the device. For an initial interval after actuation, motion detectors sense movement, to assure that personnel have evacuated the space to be sterilized. Subsequently, UV-C generators, such as a bank of mercury bulbs, generate intense levels of UV-C.

After the bulbs have reached a steady state of output, an array of UV-C sensors scan the room, and determine the darkest area, or the area reflecting the lowest level of UV-C back to the sensors. A BASIC Stamp contained in the device calculates the time required to obtain a bactericidal dose of UV-C reflected back from darkest area. The UVAS transmits the calculated dose of UV-C, as well as other monitoring information, to the remote control where it is displayed to the operator. Once a bactericidal dose has been reflected to all the sensors, the unit notifies the operator and shuts down. By relying on reflected doses rather than direct exposure, the UVAS is able to sterilize or sanitize all surfaces within the room that are within view of an exposed wall or ceiling. The pathogenic bacteria in the room have been effectively eliminated.

DESCRIPTION OF THE DRAWINGS

FIG. **1** is a top plan view of the device.

FIG. **2** is a side elevation of the device.

FIG. **3** is a front elevation of the device.

FIG. **4** is a schematic of the device.

FIG. **5** is a schematic of the controls of the device.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawing figures, the UVAS is mounted on a rolling base **2** to provide portability. FIG. **2**. An adjustable handle **3** is provided for transporting the device. The base includes a box **4** which could measure 30×20 cm, and in which is housed circuits, a power supply for the DC components, and the bulb ballasts. A central post rises **6** from the base to an overall height of, for example, 220 cm.

Around the central post are banks of UV-C emitting bulbs. In the embodiment as shown, six pairs of medium pressure mercury bulbs **8** are present, with each pair positioned equidistant from the pair on each side, so that they are present at 60° around the device. The bulbs may be 48-inch long, 115-Watt germicidal lamps that produce 300 micro-

watts of ultraviolet radiation at 1 meter. Each pair of bulbs is preferred to provide not less than 800 of coverage, so that 3600 coverage is assured.

A control box **10** on top of the unit contains wireless components, the UV-C sensor array, a bank of BASIC Stamps, motion detectors **12**, and audible **20** and visible alarms **22**. A power switch **14** is provided on the exterior of the device. A series of plugs **16** for control functions are also provided. A power cord **18** is provided.

Referring now to FIG. **4**, three door contacts **24** are shown. These contacts are placed in one or more of the doors of the room in which the device is operating. The door contacts are switches which disable the device if any one of the switches is opened, such as by opening the door. The connectors may be disabled in situations where they would be unnecessarily redundant. The motion detectors **12** are immediately activated upon activation of the device and prior to powering of the ballasts **26** and the bulbs, by means of the time delay **28**. If the motion detectors sense motion at any time during the operation of the device, power to the ballasts and the bulbs is immediately disabled. A preferred embodiment has three 120° passive ultrasonic motion detectors located on top of the device to provide coverage about the entire perimeter of the device.

The UVAS is controlled by a series of programmable BASIC Stamps **32**. The BASIC Stamps are contained in the control box **10**. BASIC Stamp® II, which is available from Parallax, Inc of Rocklin, Calif. may be used.

The BASIC Stamps continuously receive a voltage input from sensors which receive reflected UV-C radiation. The sensors continuously sense the level of UV-C radiation which is reflected back to the device from 360° around the device. Eight sensors may be used. Each sensor converts the measurement of the level of radiation to a voltage output, which is transmitted to the BASIC Stamp. The BASIC Stamp samples the voltage received at intervals and adds the cumulative total of the voltage received. When the BASIC Stamp determines that the reflected UV-C radiation received by each and every sensor has reached the predetermined minimum cumulative total, the BASIC Stamp causes the device to shut down, and a signal is given to the operator that the process has been completed. The BASIC Stamp is programmable to measure voltage inputs as required by the particular application.

The BASIC Stamps receive commands from a wireless remote control **30**. A switch activates the remote control. Entry of a security code allows the operator to begin sending commands to the bank of BASIC Stamps. Commands include Activate, Shutdown, enter Sterilization Mode, or enter Sanitize Mode. The remote is in two-way communication with the UVAS and displays data from the sensor array, time left to sterilize or sanitize the room, and in case of bulb failure, the status of all numbered bank of bulbs. If two-way communication with the remote is lost, the unit shuts down.

The BASIC Stamps activate the motion detectors at least one minute prior to activation of the UV-C bulbs and continue to monitor the detectors. They perform all calculations regarding bactericidal doses, store cumulative dosing data, and system checks to alert the operator of bulb failure. This is needed since no one can actually look at the unit to check for burned out bulbs or damaged banks. The stamps can be programmed by attaching them to a personal computer via a serial port connection, thus allowing alteration to the algorithms to accommodate special circumstances.

An example of a protocol for using the device is described.

1. An operator rolls the UVAS into the room to be sterilized. After checking the room for occupants, the operator leaves with the remote control.

2. After securing the room, the operator enters into the remote control a security code, whereupon the operator is prompted to press an "on" switch on the remote control, activating the UVAS.

3. The audible voice alarms and the motion detectors activate and stay on until the entire cycle has been complete. Should the UVAS detect motion, the unit automatically deactivates itself until the operator re-enters the room and trips a breaker, thus preventing the operator from re-activating the unit and harming an occupant present in the room.

4. The motion detectors stay on for a preset time, such as one minute, prior to powering the mercury bulbs and then stay active until the cycle is complete and the bulbs are powered down.

5. The bulbs are powered, and when sufficient time has elapsed to allow the bulbs to reach a steady state output (one minute or less), the BASIC Stamp reads data from all the individual sensors located on the array. The array senses 360 degrees at a minimum with overlapping of their window of view. They are oriented away from the UVAS, thus measuring the dose of UV-C reflected back to the unit. This data is fed into the microcontroller where it is integrated to compute cumulative exposure of UV-C reflected back from each sensor in the array.

6. Based on the least reflective surface or direction (of several thousand "snapshots") the microcontroller calculates the time the unit will need to stay activated to allow a bactericidal dose of UV-C to be reflected back to the unit from all directions.

7. Once sufficient time for a lethal dose of UV-C to be reflected back to the unit has elapsed, the unit powers down the bulbs and sounds an "All Clear" alert to the operator.

Upon completion of the cycle, the unit has sterilized all the exposed surfaces within the room, including the primary shadows such as the back or wall side of all rails, cabinets which are not against the wall, and tables. Surfaces not directly exposed to the UV-C are sterilized by UV-C reflected from the walls and ceilings.

Trials of the UVAS in actual operating rooms and endoscopy suites and exam rooms as well as simulated trials have been performed. At direct exposure from two meters, the unit is able to reduce colony counts of common hospital pathogens (*staphaloccocus Aureus*, pseudomonas, and *Escherichia coli*) by a minimum of 99.9% in one minute and achieved sterilization in 10 minutes. Five of nine surfaces were completely sterile after one minute. Subsequent trials of a unit modified to increase reflectance off the unit itself sterilized the surfaces of the same bacterial species within one minute. In one trial, the back of an exam chair was contaminated with pseudomonas, *Escherichia coli*, and staphylococcus aureaus bacteria from slurries prepared by a hospital microbiology lab. The surface was the cultured for a control prior to using the unit and were shown to grow greater than 100,000 colonies of bacteria. It was then cultured at ten minutes and twenty minutes after activation of the unit. The test surface was not in direct line of sight of the UVAS and received only reflected doses of UV-C. Cultures using convex agar plates designed for surface cultures were used and incubated by a hospital microbiology lab. The control cultures grew greater than 100,000 colonies of all three species. The ten minute and twenty minute cultures showed no growth, demonstrating the ability of the unit to sterilize surfaces using only reflected doses.

The estimated reflection from the wall in the test room was only 3%. Reflection below three percent is not desirable, since the increased exposure time required to achieve an effective dose may result in degradation of articles which are present in the room and which are exposed to direct UV-C radiation. Through the use of paint that produces a painted wall which reflects 50–85% of the UV-C, the efficiency of the device is increased, allowing for greatly decreased exposure times.

In most environments, there is a presence of what microbiology labs label as "wild spore forms" of bacteria. These bacteria are not known to cause human disease, and yet, are resistant to low doses of UV-C. The dual programming modes of the unit allow treatment as required. One mode (Sanitize) kills all known pathogens and requires a lower exposure and thus shorter time. The other mode (Sterilize) kills all species of bacteria and requires greater cumulative doses and therefore more time.

The Ultraviolet Area Sterilizer self monitors bactericidal levels. Reflected doses of UV-C are measured, and the device remains activated until bactericidal levels are received. This ensures that areas in relative shadow and not in direct line of sight with the unit are sterilized. Also, the unit can be set to sanitize (kill common pathogens) or sterilize (kill all microbes).

Without adequate safety features, daily use of intense UV-C is dangerous and impractical. The device has motion detectors which assure the room is vacant of personnel prior to activation. Hard wired plugs on the unit are available for additional door, window, or other entry monitoring devices special situation may dictate. Once activated, the unit shuts down instantly when motion occurs anywhere in the room being sterilized. If the UVAS loses two-way communication with the remote control it also shuts down. In daily use, safety protocols commonly used in hospitals such as those in use for laser and x-ray devices may be implemented.

The UVAS is able to sanitize or sterilize all exposed surfaces in a room. It is able to do so safely, leave no residual toxins or radiation, and generates no adverse environmental side products. In addition, the UVAS is able to notify the operator of the time required to perform this task and automatically shuts down upon completion of sterilization. The inventor has performed tests to prove the efficacy of the UVAS, all of which have been successful. The only limiting factor encountered to date is the reflectivity of some paints and other surfaces which absorb rather than reflect UV-C, requiring prolonged exposures of twenty minutes or greater. Specially reflective paints may be included in this method of area sterilization.

What is claimed is:

1. A method of sterilizing an area using ultraviolet radiation, comprising the steps of:

(a) causing ultraviolet-C radiation to be emitted within an enclosed area;

(b) measuring a reflection of ultraviolet-C radiation from each of multiple points within said enclosed area;

(c) calculating the ultraviolet-C radiation level necessary to sterilize said enclosed area and comparing it with the measured reflected ultraviolet-C radiation;

(d) terminating the emission of ultraviolet-C radiation after determining that the required minimum ultraviolet-C radiation has been reflected from each of said multiple points within said enclosed area.

2. A method of sterilizing an area using ultraviolet radiation as described in claim **1**, wherein motion within said enclosed area is detected prior to the initiation of emission of ultraviolet-C radiation.

3. A device for sterilizing an area using ultraviolet radiation, comprising:

(a) a base;

(b) a plurality of ultraviolet-C radiation emitters, wherein said plurality of ultraviolet-C radiation emitters are positioned on said base to emit ultraviolet-C radiation 360 degrees around said base and above said base;

(c) at least one radiation sensor which is attached to said base which receives reflected ultraviolet-C radiation from multiple points in an area that is external to the device, wherein said sensor measures said reflected ultraviolet-C radiation.

4. A device for sterilizing an area using ultraviolet radiation as described in claim **3**, further comprising a motion detector which communicates with said plurality of ultraviolet-C radiation emitters.

5. A device for sterilizing an area using ultraviolet radiation as described in claim **3**, wherein said area that is external to the device is a room.

6. A method of disinfecting an area using ultraviolet radiation, comprising the steps of:

(a) causing an emission of ultraviolet-C radiation within an enclosed area;

(b) providing at least one sensor that receives only reflected ultraviolet-C radiation from said emission of ultraviolet-C radiation;

(c) measuring a level of reflected ultraviolet-C radiation received by said at least one sensor; and

(d) terminating the emission of ultraviolet-C radiation upon determining that a cumulative level of reflected ultraviolet-C radiation has been received by said at least one sensor.

7. A method of disinfecting an area using ultraviolet radiation as described in claim **6**, wherein said enclosed area is a room having a plurality of walls, and wherein a portion of said emission of ultraviolet-C radiation is reflected from said plurality of walls, and wherein ultraviolet-C radiation reflected from said walls is received by said at least one sensor.

8. A method of disinfecting an area using ultraviolet radiation as described in claim **7**, wherein said ultraviolet-C radiation is emitted from a location that is remote from said plurality of walls, and said at least one sensor receives reflected radiation from said plurality of walls.

9. A method of disinfecting an area using ultraviolet radiation as described in claim **8**, wherein said at least one sensor is positioned at a location that is remote from said plurality of walls.

10. A method of disinfecting an area using ultraviolet radiation as described in claim **7**, wherein said room further comprises a ceiling, and ultraviolet-C radiation is emitted from a location that is remote from said plurality of walls, and said at least one sensor receives reflected radiation from said plurality of walls and from said ceiling.

11. A method of disinfecting an area using ultraviolet radiation as described in claim **10**, wherein said at least one sensor is positioned at a location that is remote from said plurality of walls.

12. A method of disinfecting an area using ultraviolet radiation as described in claim **6**, wherein said method comprises providing at least two sensors that receive only reflected ultraviolet-C radiation from said emission of ultraviolet-C radiation, and wherein a level of reflected ultraviolet-C radiation received by each of said at least two sensors is measured for said each of said at least two sensors, and the emission of ultraviolet-C radiation is terminated

after determining that a minimum cumulative level of reflected ultraviolet-C radiation has been received by said each of said at least two sensors.

13. A method of disinfecting an area using ultraviolet radiation as described in claim **6**, wherein said at least one ultraviolet-C radiation sensor is positioned to receive reflected ultraviolet-C radiation from 360 degrees around said at least one ultraviolet-C radiation sensor.

14. A device for disinfecting an area using ultraviolet radiation, comprising:

(a) at least one ultraviolet-C emitter which emits ultraviolet-C radiation which is subsequently reflected by a surface in the area; and

(b) at least one ultraviolet-C radiation sensor that is positioned relative to said at least one ultraviolet-C emitter to receive only reflected ultraviolet-C radiation.

15. A device for disinfecting an area using ultraviolet radiation as described in claim **14**, wherein said at least one ultraviolet-C radiation sensor measures ultraviolet-C radiation received by said at least one ultraviolet-C radiation sensor, and said device comprises means for terminating an emission of ultraviolet-C radiation from at least one ultraviolet-C radiation emitter upon determining that a cumulative level of reflected ultraviolet-C radiation has been received by said at least one ultraviolet-C radiation sensor.

16. A device for disinfecting an area using ultraviolet radiation as described in claim **14**, wherein said device comprises at least two ultraviolet-C radiation sensors that are positioned relative to said at least one ultraviolet-C radiation emitter to receive only ultraviolet-C radiation that is emitted by said at least one ultraviolet-C radiation emitter and is subsequently reflected, and said device comprises means for terminating an emission of ultraviolet-C radiation from said at least one ultraviolet-C radiation emitter upon determining that a cumulative level of reflected ultraviolet-C radiation has been received by each of said at least two ultraviolet-C radiation sensors.

17. A device for disinfecting an area using ultraviolet radiation as described in claim **14**, wherein said at least one ultraviolet-C radiation emitter is positioned to direct ultraviolet-C radiation 360 degrees around said at least one ultraviolet-C radiation emitter and above said at least one ultraviolet-C radiation emitter, and said at least one ultraviolet-C radiation sensor is positioned to receive reflected ultraviolet-C radiation from 360 degrees around said at least one ultraviolet-C radiation emitter.

18. A device for disinfecting an area using ultraviolet radiation as described in claim **14**, wherein said at least one ultraviolet-C radiation sensor measures ultraviolet-C radiation received by said at least one ultraviolet-C radiation sensor, and the device further comprises a computer, wherein said computer terminates an emission of ultraviolet-C radiation from said at least one ultraviolet-C radiation emitter upon determining that a cumulative level of reflected ultraviolet-C radiation has been received by said at least one ultraviolet-C radiation sensor.

19. A device for disinfecting an area using ultraviolet radiation as described in claim **14**, wherein the device comprises at least two sensors that are positioned to receive only ultraviolet-C radiation that is emitted by said at least one ultraviolet-C radiation emitter and is subsequently reflected, and the device comprises a computer, wherein said computer terminates an emission of ultraviolet-C radiation from said at least one ultraviolet-C radiation emitter upon determining that a cumulative level of reflected ultraviolet-C radiation has been received by each of said at least two ultraviolet-C radiation sensors.

20. A device for disinfecting an area using ultraviolet radiation as described in claim **14**, wherein said at least one ultraviolet-C radiation emitter and said at least one ultraviolet-C radiation sensor are positioned in a room, wherein said room comprises walls, and wherein said at least one ultraviolet-C radiation sensor is positioned remotely from said walls.

* * * * *

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(12) **United States Patent**
Deal

(10) **Patent No.: US 6,911,177 B2**
(45) **Date of Patent: *Jun. 28, 2005**

(54) **ULTRAVIOLET AREA STERILIZER AND METHOD OF AREA STERILIZATION USING ULTRAVIOLET RADIATION**

(76) Inventor: **Jeffrey L. Deal**, 1649 Savage Rd., Charleston, SC (US) 29407

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 496 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **10/029,787**

(22) Filed: **Oct. 26, 2001**

(65) **Prior Publication Data**

US 2002/0085947 A1 Jul. 4, 2002

Related U.S. Application Data

(63) Continuation-in-part of application No. 09/665,151, filed on Sep. 19, 2000, now Pat. No. 6,656,424.

(51) **Int. Cl.**[7] **A61L 2/00**; G01N 21/00; G01N 23/00; A62B 7/08; B01J 19/08

(52) **U.S. Cl.** **422/24**; 422/1; 422/3; 422/62; 422/121; 422/186.04; 422/300; 422/307; 250/455.11

(58) **Field of Search** 422/1, 3–5, 22, 422/24, 62, 119–121, 186, 186.04, 186.3, 292, 300, 305, 307, 900, 906–907; 250/455.11

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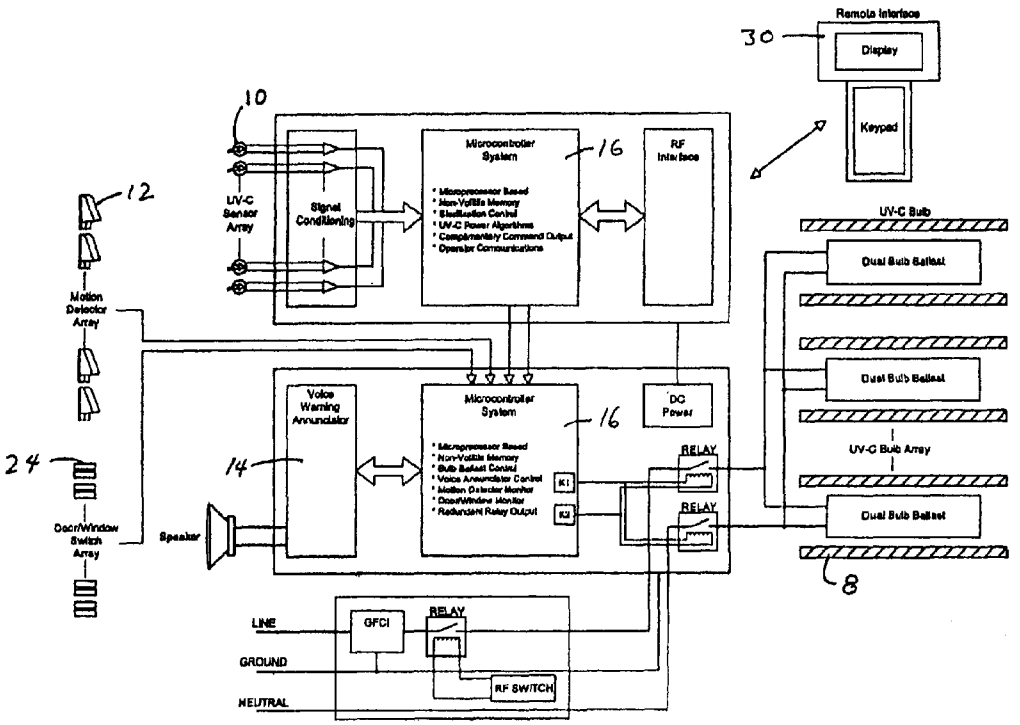
Assistant Examiner—Monzer R. Chorbaji
(74) *Attorney, Agent, or Firm*—B. Craig Killough

(57) **ABSTRACT**

An ultraviolet area sterilizer (UVAS) is mobile or stationary. The UVAS is positioned in a room, such an operating room or intensive care unit. Motion detectors sense movement, to assure that personnel have evacuated the space to be sterilized. Subsequently, UV-C generators, such mercury bulbs, generate UV-C from multiple locations within the room or other enclosed space. Multiple UV-C sensors scan the room, and determine the area reflecting the lowest level of UV-C back to the sensors. The device calculates the time required to obtain a bactericidal dose of UV-C reflected back to the sensors. Once an effective bactericidal dose has been reflected to all the sensors, the unit notifies the operator and shuts down.

14 Claims, 3 Drawing Sheets



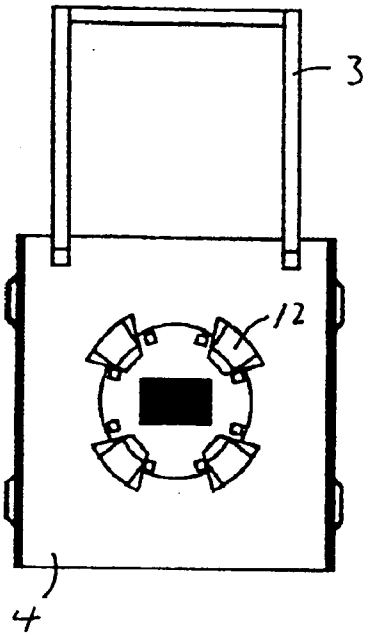


Fig. 1

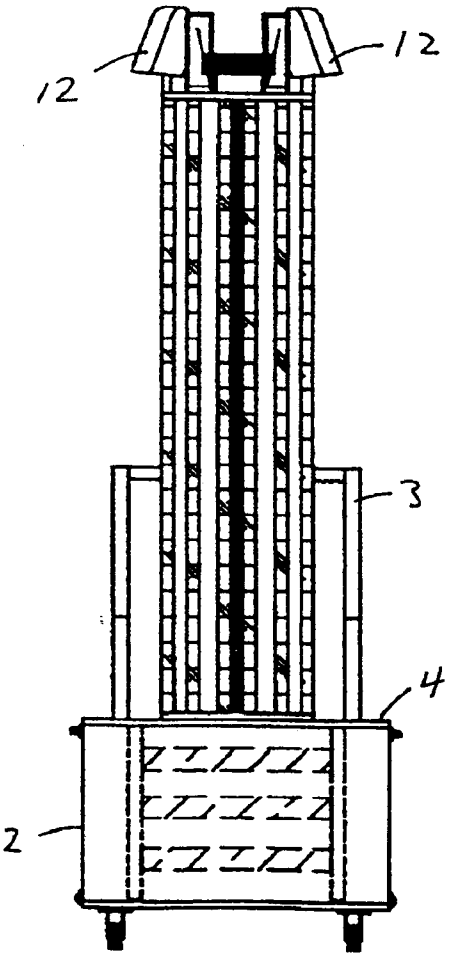


Fig. 2

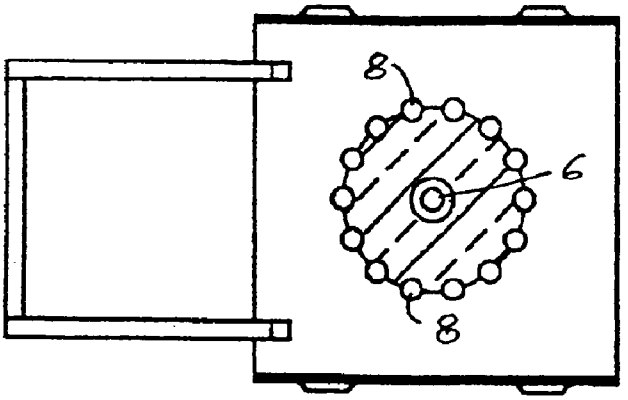


Fig. 3

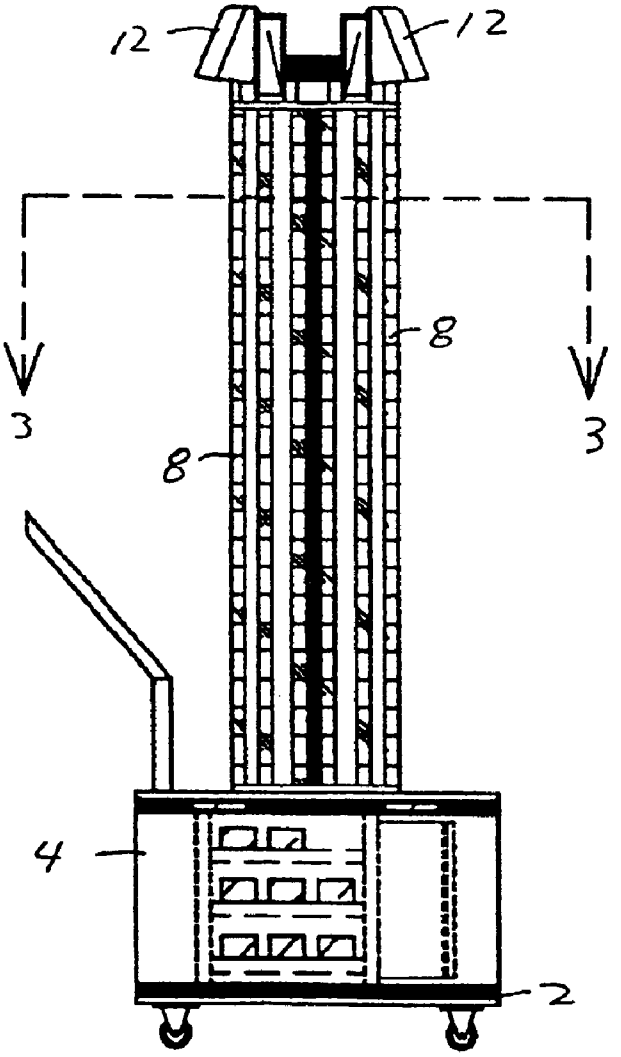


Fig. 4

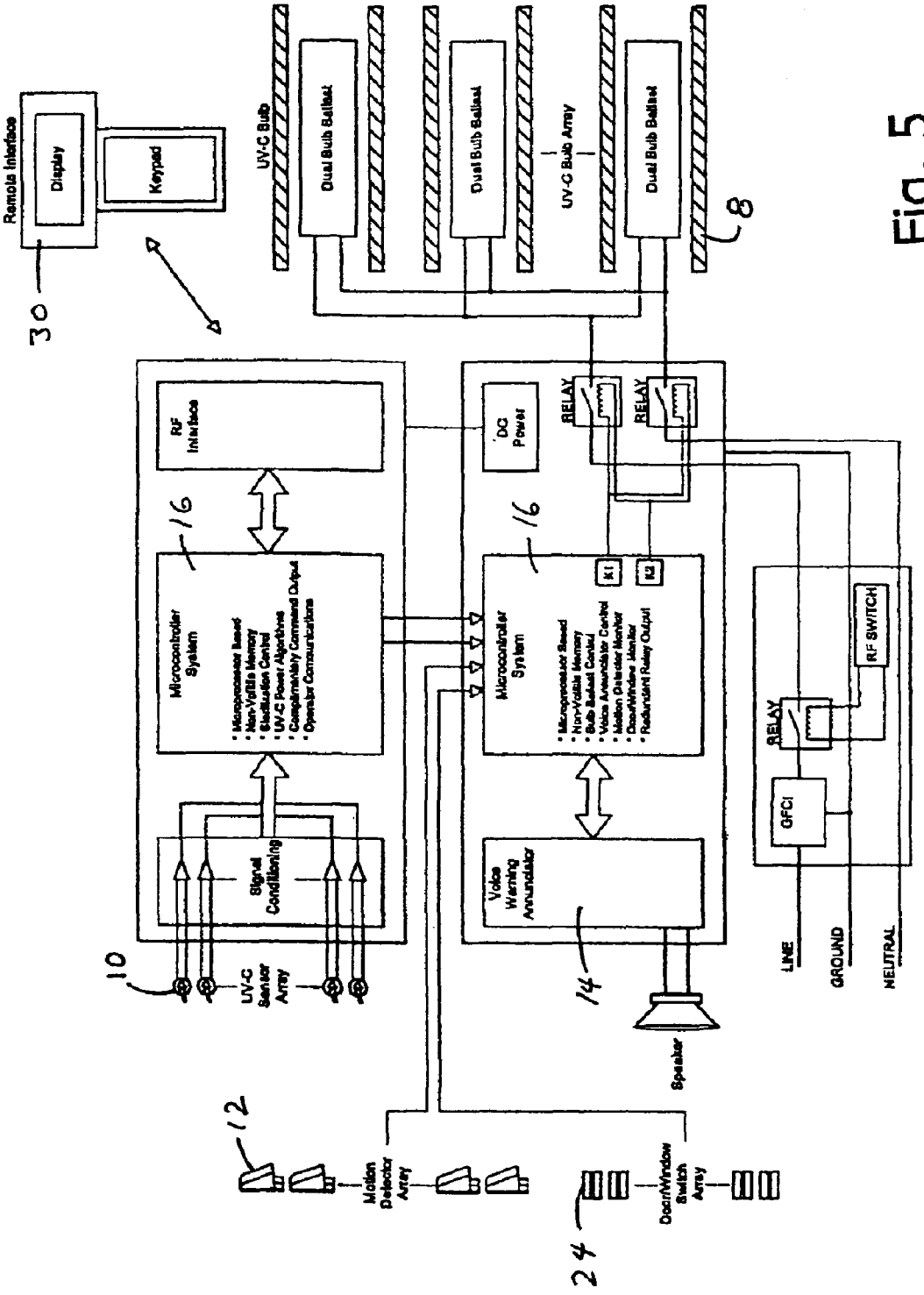

Remote Interface
Display
Keypad
30
UV-C Bulb
Dual Bulb Ballast
Dual Bulb Ballast
UV-C Bulb Array
Dual Bulb Ballast
8
RF Interface
16
Microcontroller System
DC Power
RELAY
RELAY
16
Microcontroller System
K1
K2
RELAY
RF SWITCH
GFCI
Signal Conditioning
10
UV-C Sensor Array
Voice Warning Annunciator
14
Speaker
LINE
GROUND
NEUTRAL
12
Motion Detector Array
Door/Window Switch Array
24

Fig. 5

ULTRAVIOLET AREA STERILIZER AND METHOD OF AREA STERILIZATION USING ULTRAVIOLET RADIATION

This application is a continuation-in-part of application Ser. No. 09/665,151 filed Sep. 19, 2000 now U.S. Pat. No. 6,656,424.

FIELD THE INVENTION

This invention relates to methods and devices for bacterial, fungal and/or viral sterilization, and is more particularly directed to a method and device for sterilizing rooms and similar enclosed areas.

BACKGROUND OF THE INVENTION

Nosocomial, or hospital acquired, infections are common, costly, and sometimes lethal. A recent review of such infections in the cardiac surgery unit of a major hospital revealed a nosocomial infection rate of 27.3% that more than doubled the mortality rate for afflicted patients. The nature of bacteria acquired in the hospital setting differs significantly from bacteria found in a community setting primarily in their resistance to antibiotic therapy.

> "Historically, *staphylococci, pseudomonads*, and *Escherichia coli* have been the nosocomial infection troika; nosocomial pneumonia, surgical wound infections, and vascular access-related bacteremia have caused the most illness and death in hospitalized patients; and intensive care units have been the epicenters of antibiotic resistance. Acquired antimicrobial resistance is the major problem, and vancomycin-resistant *Staphylococcus aureus* is the pathogen of greatest concern. The shift to outpatient care is leaving the most vulnerable patients in hospitals. Aging of our population and increasingly aggressive medical and surgical interventions, including implanted foreign bodies, organ transplantations, and xenotransplantation, create a cohort of particularly susceptible persons. Renovation of aging hospitals increases risk of airborne fungal and other infections.[1]"

[1] Nosocomial infection update.

Significant morbidity, mortality, and costs are associated with these infections. Many factors contribute to these dangerous infections. Most notably are the overuse of antibiotics and poor personal hygiene such as hand washing. Abundant evidence exists, however, that the hospital environment itself contributes to the problem by harboring virulent strains of bacteria, fungi, and viruses, and that many methods commonly used are ineffective and may actually spread contaminants.

Attempts to eradicate surface contaminates from the hospital setting have varied greatly in strategy and success. These have ranged from antiseptic soaps to fumigation with formaldehyde gas. Topical antiseptics are problematic for several reasons. First, they have recently been shown to actually induce antibiotic resistances and thus may be adding to the problem. Secondly, many surfaces such as keyboards, television sets, and monitoring controls are difficult if not impossible to decontaminate with liquid disinfectants without harming the electronics. Gas disinfection, while effective, is time consuming, hazardous to workers, and environmentally unwise.

Ultraviolet (UV) light has been long used for disinfection and sterilization. Ultraviolet light may be produced artificially by electric-arc lamps. Recently, the widespread availability of low to medium pressure mercury bulbs has led to the development of devices which use UV-C to decontaminate water supplies. UV-C is a high frequency wavelength of light within the ultraviolet band and has been shown to be the most bactericidal type of ultraviolet light. UV-C has wavelengths of about 2800 Å to 150 Å. To date, there are no published efforts to use UV-C to decontaminate or disinfect larger areas such as operating rooms. The only recent availability of the appropriate bulbs as well as significant safety concerns regarding worker exposure to UV-C likely contribute to the lack of efforts to use UV-C outside of self-contained water purification systems.

Weinstein RA Cook County Hospital, Divsion of Infectious Diseases, Chicago, Ill. 60612 Emerg Infect Dis 1998 Jul–Sep;4(3):416–20

SUMMARY OF THE INVENTION

The ultraviolet area sterilizer of the present invention (UVAS) is a mobile, automated room sterilizer. Stationary units would use the same techniques and strategy but could be built into the room itself. The UVAS is positioned in a room, such an operating room or intensive care unit, where concern exists regarding the presence of pathogenic bacteria on environmental surfaces. A wireless remote control may be used to activate the device. For an initial interval after actuation, motion detectors sense movement, to assure that personnel have evacuated the space to be sterilized. Subsequently, UV-C generators, such as a bank of mercury bulbs, generate intense levels of UV-C.

After the bulbs have reached a steady state of output, an array of UV-C sensors scan the room, and determine the darkest area, or the area reflecting the lowest level of UV-C back to the sensors. A basic stamp contained in the device calculates the time required to obtain a bactericidal dose of UV-C reflected back from darkest area. The UVAS transmits the calculated dose of UV-C, as well as other monitoring information, to the remote control where it is displayed to the user. Once a bactericidal dose has been reflected to all the sensors, the unit notifies the user and shuts down. By relying on reflected doses rather than direct exposure, the UVAS is able to sterilize or sanitize all surfaces within the room that are within view of an exposed wall or ceiling. The pathogenic bacteria in the room have been effectively eliminated.

DESCRIPTION OF THE DRAWINGS

FIG. **1** is a top plan view of the device.

FIG. **2** is a front elevation of the device.

FIG. **3** is a sectioned view taken essentially along **3**—**3** of FIG. **4**.

FIG. **4** is a side elevation of the device.

FIG. **5** is a schematic of the controls of the device.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawing figures, the UVAS is mounted on a rolling base **2** to provide portability. FIG. **2**. An adjustable handle **3** is provided for transporting the device. The base includes a box **4** which could measure 30×20 cm, and in which is housed circuits, a power supply for the DC components, and the bulb ballasts. A central post rises **6** from the base to an overall height of, for example, 220 cm.

Around the central post are banks of UV-C emitting bulbs. In the embodiment as shown, six pairs of medium pressure mercury bulbs **8** are present, with each pair positioned equidistant from the pair on each side, so that they are present at 60° around the device. The bulbs may be 48-inch

long, 115-Watt germicidal lamps that produce 300 microwatts of ultraviolet radiation at 1 meter. Each pair of bulbs is preferred to provide not less than 80° of coverage.

A control box on top of the unit contains wireless components, the UV-C sensor array **10**, a bank of basic stamps, motion detectors **12**, and audible and visible alarms. A power switch is provided on the exterior of the device. A series of plugs for control functions are also provided. A power cord is provided.

Referring now to FIG. **4**, three door contacts **24** are shown. These contacts are placed in one or more of the doors of the room in which the device is operating. The door contacts are switches which disable the device if any one of the switches is opened, such as by opening the door. The motion detectors **12** are immediately activated upon activation of the device and prior to powering of the ballasts **26** and the bulbs, by means of the time delay **28**. If the motion detectors sense motion at any time during the operation of the device, power to the ballasts and the bulbs is immediately disabled. A preferred embodiment has three 120° passive ultrasonic motion detectors located on top of the device.

The UVAS is controlled by a series of programmable basic stamps which receive commands from a wireless remote control **30**. A switch activates the remote control. Entry of a security code allows the user to begin sending commands to the bank of basic stamps. Commands include Activate, Shutdown, enter Sterilization Mode, or enter Sanitize Mode. The remote is in two-way communication with the UVAS and displays data from the sensor array, time left to sterilize or sanitize the room, and in case of bulb failure, the status of all numbered bank of bulbs. If two-way communication with the remote is lost, the unit shuts down.

The basic stamps activate the motion detectors at least one minute prior to activation of the UV-C bulbs and continue to monitor the detectors. They perform all calculations regarding bactericidal doses, store cumulative dosing data, and system checks to alert the user of bulb failure. This is needed since no one can actually look at the unit to check for burned out bulbs or damaged banks. The stamps can be programmed by attaching them to a personal computer via a serial port connection, thus allowing alteration to the algorithms to accommodate special circumstances.

An additional embodiment of the device provides UV-C bulbs or lamps that are placed strategically at various locations within, or directed towards, the space to be treated. The bulbs may be located at two or more locations in a room to be treated. The bulbs may be connected to the base unit, and positioned at remote locations from the base. The device in this embodiment may utilize a single bank of sensors to measure doses at locations within the area to be treated. Alternatively, multiple remote sensors, or a combination of remote and central sensors, may be provided to measure and control the dosing of UV-C to the treated area.

An example of a protocol for using the device is described.

1. A user rolls the UVAS into the room to be sterilized. After checking the room for bystanders, the user leaves with the remote control.

2. After securing the room, enters into the remote control the security code, then is prompted to presses an "on" switch on the remote control, thus activating the UVAS.

3. The audible voice alarms **14** and the motion detectors activate and stay on until the entire cycle has been complete. Should the UVAS detect motion, the unit automatically deactivates itself until the user re-enters the room and trips a breaker, thus preventing the user from re-activating the unit and harming a bystander left in the room.

4. The motion detectors stay on for a preset time, such as one minute, prior to powering the mercury bulbs and then stay active until the cycle is complete and the bulbs are powered down.

5. The bulbs are powered, and when sufficient time has elapsed to allow the bulbs to reach a steady state output (one minute or less), the basic stamp reads data from all the individual sensors located on the array. The array senses 360 degrees at a minimum with overlapping of their window of view. They are oriented away from the UVAS, thus measuring the dose of UV-C reflected back to the unit. This data is fed into the microcontroller **16** where it is integrated to compute cumulative exposure of UV-C reflected back from each sensor in the array.

6. Based on the least reflective surface or direction (of several thousand "snapshots") the microcontroller calculates the time the unit will need to stay activated to allow a bactericidal dose of UV-C to be reflected back to the unit from all directions.

7. Once sufficient time for a lethal dose of UV-C to be reflected back to the unit has elapsed, the unit powers down the bulbs and sounds an "All Clear" alert to the user.

Upon completion of the cycle, the unit has sterilized all the exposed surfaces within the room, including the primary shadows such as the back or wall side of all rails, cabinets which are not against the wall, and tables.

Trials of the UVAS in actual operating rooms and endoscopy suites and exam rooms as well as simulated trials have been performed. At direct exposure from two meters, the unit is able to reduce colony counts of common hospital pathogens by a minimum of 99.9% in one minute and achieved sterilization in 10 minutes. In one trial, the back of an exam chair was contaminated with *pseudomonas a., e. coli*, and *staphylococcus aureaus* bacteria from slurries prepared by a hospital microbiology lab. The surface was the cultured for a control prior to using the unit. It was then cultured at ten minutes and twenty minutes after activation of the unit. The test surface was not in direct line of sight of the UVAS and received only reflected doses of UV-C. Cultures using convex agar plates designed for surface cultures were used and incubated by a hospital microbiology lab. The control cultures grew greater than 100,000 colonies of all three species. The ten minute and twenty minute cultures showed no growth, demonstrating the ability of the unit to sterilize surfaces using only reflected doses. The estimated reflection from the wall in the test room was only 3%. Through the use of paint that reflects 50–85% of the UV-C, the efficiency of the device is increased, allowing for decreased exposure times.

In most environments, there is a presence of what microbiology labs label as "wild spore forms" of bacteria. These bacteria are not known to cause human disease, and yet, are resistant to low doses of UV-C. The dual programming modes of the unit allow treatment as required. One mode (Sanitize) kills all known pathogens and requires a lower exposure and thus shorter time. The other mode (Sterilize) kills all species of bacteria and requires greater cumulative doses and therefore more time.

The Ultraviolet Area Sterilizer self monitors bactericidal levels. Reflected doses of UV-C are measured, and the device remains activated until bactericidal levels are received. This ensures that areas in relative shadow and not in direct line of sight with the unit are sterilized. Also, the unit can be set to sanitize (kill common pathogens) or sterilize (kill all microbes).

Without adequate safety features, daily use of intense UV-C is dangerous and impractical. The device has motion detectors that assure the room is vacant of personnel prior to activation. Hard wired plugs on the unit are available for additional door, window, or other entry monitoring devices special situation may dictate. Once activated, the unit shuts down instantly when motion occurs anywhere in the room being sterilized. If the UVAS loses two-way communication with the remote control it also shuts down. In daily use, safety protocols commonly used in hospitals such as those in use for laser and x-ray devices may be implemented.

The UVAS is able to sanitize or sterilize all exposed surfaces in a room. It is able to do so safely, leave no residual toxins or radiation, and generates no adverse environmental side products. In addition, the UVAS is able to notify the user of the time required to perform this task and automatically shuts down upon completion of sterilization. The inventor has performed tests to prove the efficacy of the UVAS, all of which have been successful. The only limiting factor encountered to date is the reflectivity of some paints and other surfaces which absorb rather than reflect UV-C, requiring prolonged exposures of twenty minutes or greater. Highly reflective paints are beneficial to the method of area sterilization disclosed herein.

What is claimed is:

1. A method of sterilizing an area using ultraviolet radiation, comprising the steps of:

(a) causing ultraviolet-C radiation to be emitted from multiple positions within an enclosed area;

(b) measuring a reflection of ultraviolet-C radiation from the multiple positions within said enclosed area;

(c) calculating an ultraviolet-C radiation reflectance level necessary to sterilize said enclosed area and comparing it with measured reflected ultraviolet-C radiation; and

(d) terminating the emission of ultraviolet-C radiation after determining that the required ultraviolet-C radiation reflectance level has been reflected from the multiple positions within said enclosed area.

2. A method of sterilizing an area using ultraviolet radiation as described in claim **1**, further comprising the step of detecting motion within said enclosed area prior to an initiation of emission of ultraviolet-C radiation.

3. A method of sterilizing an area using ultraviolet radiation as described in claim **1**, further comprising the steps of detecting motion within said enclosed area prior to an initiation of emission of ultraviolet-C radiation, and disabling emission of said ultraviolet-C radiation upon detecting motion.

4. A method of sterilizing an area using ultraviolet radiation as described in claim **1**, wherein reflected ultraviolet radiation is measured from at least two positions within said enclosed area that are remote from each other.

5. A method of sterilizing an area using ultraviolet radiation as described in claim **1**, wherein a wall of said enclosed area reflects at least 50% of ultraviolet radiation received by said wall.

6. A method of sterilizing an area using ultraviolet radiation as described in claim **1**, further comprising the step of detecting motion within said enclosed area prior to an initiation of emission of ultraviolet-C radiation.

7. A device for sterilizing an area using ultraviolet radiation, comprising:

(a) a base;

(b) a plurality of ultraviolet-C radiation emitters, wherein said plurality of ultraviolet-C radiation emitters are located in at least two places within an enclosed area to be treated, with each of two places remote from each other, and wherein said ultraviolet-C radiation emitters are directed towards an enclosed area to be treated; and

(c) at least one radiation sensor which receives reflected ultraviolet-C radiation, wherein said radiation sensor measures said reflected ultraviolet-C radiation.

8. A device for sterilizing an area using ultraviolet radiation as described in claim **7**, further comprising a motion detector which communicates with said plurality of ultraviolet-C radiation emitters.

9. A device for sterilizing an area using ultraviolet radiation as described in claim **7**, further comprising a motion detector which communicates with said plurality of ultraviolet-C radiation emitters, wherein said motion detector prevents emission of ultraviolet-C radiation upon detecting motion within said enclosed area.

10. A device for sterilizing an area using ultraviolet radiation as described in claim **7**, further comprising at least two radiation sensors that receive reflected ultraviolet-C radiation, wherein each of said at least two radiation sensors is located within the enclosed area to be treated, and at least one of said at least two radiation sensors is remote from at least one other of said at least two radiation sensors.

11. A method of sterilizing an area using ultraviolet radiation, comprising the steps of:

(a) causing ultraviolet-C radiation to be emitted from multiple positions within an enclosed area;

(b) measuring a cumulative reflection of ultraviolet-C radiation from each of the multiple positions within said enclosed area;

(c) calculating an ultraviolet-C radiation reflectance level necessary to sterilize said enclosed area and comparing it with measured reflected ultraviolet-C radiation; and

(d) terminating emission of ultraviolet-C radiation after determining that the required ultraviolet-C radiation reflectance level has been reflected from each of the multiple positions within said enclosed area.

12. A method of sterilizing an area using ultraviolet radiation as described in claim **11**, further comprising the steps of detecting motion within said room prior to an initiation of emission of ultraviolet-C radiation, and disabling emission of said ultraviolet-C radiation upon detecting motion.

13. A method of sterilizing an area using ultraviolet radiation as described in claim **11**, wherein reflected ultraviolet radiation is measured from at least two positions within said enclosed area that are remote from each other.

14. A method of sterilizing an area using ultraviolet radiation as described in claim **11**, wherein a wall of said enclosed area reflects at least 50% of ultraviolet radiation received by said wall.

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